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A cross-sectional investigation into the antecedents and sequelae of alexithymia: a comparison of children and adults

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Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy in Psychology

to

The University of Edinburgh

Declaration

I hereby declare that this thesis is of my own composition, and that it contains no material previously submitted for the award of any other degree. The work reported in this thesis has been executed by myself, except where due acknowledgement is made in the text. The study described in Chapter 2 is currently under review at the *Child Abuse and Neglect: The International Journal* (submitted for review 8th August 2018).

Signed,

Ruth Harriet Brown

Acknowledgements

I must first extend my gratitude to Dr Bonnie Auyeung for supporting me throughout my PhD journey, your mentorship has allowed me to get to where I am today. Thank you for giving me the reassurance that I am capable of being an independent researcher and able to succeed in the field of academia. For that, I will always be eternally grateful for your supervision. I must also thank Dr Richard Shillcock for his kind encouragement, knowledge and guidance over the past three years.

I am indebted to Dr Aja Murray and Dr Mary Stewart for their willingness to share their advice with me on how I could improve my research and academic writing. Thank you for dedicating many hours of your time to reading my work and providing me with extremely helpful feedback.

To Fiona, Alice, Kirsty, Jean, Martha, Lorna and Lydia; thank you so much for working along with me in our research teams. Even after spending countless hours in the basement of the Psychology Department, we were able to seek solace in our shared humour and ability to keep the morale high. I am so grateful for meeting you all and I cannot wait to see how you all progress in your careers.

Thanks must go to all the participants and families who were willing to dedicate their time in participating in my online questionnaires, school questionnaires and laboratory tasks.

On a personal note, I want to acknowledge all my wonderful friends and family for their support over the past three years, especially my best friends Emily, Alix and Sian. Robbie, thank you for being by my side during my PhD journey, no matter what. I will always be grateful for your patience, kindness and encouragement when I needed it the most. Lastly, I dedicate this thesis to my parents, Laura and Keith Brown. I genuinely could not

have endured this ‘labour of love’ without your constant support, advice and endless proof-reading of thesis drafts. Thank you for always believing in me; I hope I have made you both proud.

Abstract

The term alexithymia, meaning “no words for emotions”, is a subclinical personality trait associated with both affective (e.g., difficulties identifying and describing emotions) and cognitive (e.g., externally oriented thinking) deficits in emotional awareness. Despite being relatively common in the general populace (~10% prevalence rate), alexithymia’s antecedents and consequences in healthy individuals remain poorly understood. As comorbid alexithymia has been found to have numerous adverse psychological and health implications in clinical populations, it is important to investigate if heightened alexithymic traits have similar negative consequences in nonclinical populations. Therefore, this thesis contains a series of novel and unique studies to clarify this.

The thesis first aimed to better understand the psychometric and behavioural correlates of alexithymia in adult individuals from the general population (Chapters 2 and 3). It has been speculated childhood trauma shares separate relationships with later-life alexithymia, depression and anxiety. Considering this, Chapter 2 aimed to ascertain alexithymia’s potential mediating role in the known relationship between childhood adversity and depressive/anxiety symptoms. A significant mediating role of the alexithymia construct, ‘difficulty identifying feelings’ was found in the relationship between psychological trauma and the development of depressive/anxiety symptoms in later-life. Next, it was of interest to assess the possible behavioural correlates of alexithymia (Chapter 3). The role of alexithymia on the known association between depressive/anxiety symptoms and attentional biases towards emotional facial expressions was then investigated. Consistent with the findings of Chapter 2, Chapter 3 identified a novel and unique relationship between the alexithymia construct ‘difficulty identifying feelings’ and decreased sensitivity towards happy facial expressions; an association once thought to be solely a consequence of depressive symptoms. In light of this, the aim of Chapter 4 was to ascertain if depressive/anxiety symptoms and

alexithymia emerge as separate psychological constructs. Chapter 4 found alexithymia distinct from co-occurring depressive/anxiety symptoms, additionally suggesting the alexithymia construct 'difficulty identifying feelings' may constitute as 'core' alexithymia. Taken together, the findings from the first section of this thesis may aid the development of treatment strategies for both clinical and at-risk healthy individuals who exhibit marked alexithymic traits.

Mental health issues are a common occurrence in preadolescents, with an estimated one in ten children in the UK suffering from a diagnosable mental health disorder. Despite this, many of these children go unrecognised and untreated. It may be speculated early-life alexithymia may exacerbate the severity of these mental health issues, however the literature on the presentation, measurement and adverse psychological consequences of alexithymia in children is currently scarce. As such, the thesis then aimed to assess alexithymic traits in preadolescent children aged 8 to 13 in a series of novel studies (Chapters 5, 6 and 7). As it has been speculated children lack the emotional introspection to adequately rate auto-evaluative measures of alexithymia, Chapter 5 aimed to assess the congruent validity of a newly published parent-rated scale of a child's alexithymic traits. When compared with a complementary self-reported measure, the two assessment tools appeared to be equally able to measure the child's alexithymia. However, unique patterns of associations emerged. Children themselves were found to be more capable at rating the internal manifestations of alexithymia (e.g., depressive symptoms), whereas parents were better at detecting the external manifestations (e.g., decreased empathy). Next, the mediating role of child alexithymia in the known association between emotion dysregulation and depressive symptoms was investigated. Results from Chapter 6 indicated both self- and parent-reported alexithymia played significant but differing roles in this relationship, dependant on the alexithymia measure's subfactor. Lastly, Chapter 7 aimed to replicate the findings from

Chapter 3 by being the first study to assess the potential influence of child alexithymia on performance in a novel emotion recognition task. In partial support of the findings from adults, parent-rated child alexithymia was found to be uniquely associated with a significant delay in recognising happy expressions. In contrast, an increase in sensitivity towards sad expressions was predominantly explained by underlying depressive symptoms. Chapters 5, 6 and 7 have provided new information on early-life alexithymia and confirmed children and adults with alexithymic traits may have similar psychopathological tendencies. Additionally, this research has highlighted some constraints in administering self-evaluative measures of alexithymia, as children may be unable to differentiate between their affective alexithymic traits and depressive symptoms. Taken together, results from the last section of the thesis may be utilised in the development of early-intervention strategies targeting at-risk children with elevated early-life alexithymic traits.

Lay Abstract

‘Alexithymia’ refers to difficulties in recognising and describing one’s emotions. Since much of the previous research has been done in people with psychiatric illnesses, little is known about the causes and consequences of alexithymia in those from the general public. As such, this thesis aimed to gain a better understanding of alexithymia’s negative effects across the ages in the general population. First, alexithymia in adults was investigated. In Chapter 2, it was found experiences of childhood psychological trauma may be a potential cause of alexithymia. Next, in Chapter 3, a possible consequence of alexithymia was investigated using an emotion recognition game. It was found individuals with alexithymia took longer to recognise happy faces compared to those without alexithymia, a finding once thought to be limited to people with depression. Lastly, Chapter 4 found that while alexithymia, depression and anxiety are related, alexithymic traits are distinct from feelings of low mood. This section of the thesis sets the groundwork for developing treatments that may reduce the negative consequences of alexithymia in at-risk individuals, discussed in the final chapter (Chapter 8).

Next, alexithymia in preadolescent children was explored. As children may lack the ability to correctly fill in questionnaires about their inner feelings, researchers often turn to the child’s parent(s)/guardian(s) to do this. Chapter 5 looked at the similarities between a child- and parent-reported alexithymia questionnaire. Results suggested that children are better at rating themselves on internal struggles (e.g., depression), whereas parents are better at rating external struggles (e.g., a lack of empathy) associated with alexithymia. As such, using both questionnaires together may give researchers a better understanding of the child’s alexithymia severity. It has been suggested depression may be caused by difficulties controlling and revaluating one’s emotions. Results from Chapter 6 found alexithymia may make a child further at-risk of depression, especially if they have difficulties in their

emotional control. Children were then asked to play the emotion recognition game used in Chapter 3. Results showed that the children's speed in recognising sad faces was mainly predicted by depressive symptoms. However, underlying alexithymia was found to make children slower to recognise happy faces, similar to the findings in adults. Taken together, results from Chapter 5, 6 and 7 have identified some of the negative consequences of early-life alexithymia that may impact on the child's wellbeing. How to identify and help children with elevated alexithymic traits was discussed in the final chapter (Chapter 8).

Table of Contents

Declaration i

Acknowledgements ii

Abstract iv

Lay Abstract vii

List of Tables and Figures xiv

List of Abbreviations xvii

Chapter 1: Introduction and Overview of Alexithymia in Adults 1

1.1. Introduction to Alexithymia in Adults 1
- 1.1.1. The History of the Alexithymia Construct 1
- 1.1.2. Measures of Alexithymia in Adults 2
- 1.1.3. The Importance of Alexithymia Research 4
- 1.1.4. The Temporal Stability of Alexithymia 6
- 1.1.5. Current Trends and Limitations of the Previous Literature in Adults 7

1.2. The Influence of Childhood Adversity on the Development of Alexithymia 9

1.3. The Behavioural Correlates of Alexithymia: An Emotion Recognition Perspective 11
- 1.3.1. The Associations between Adult Depressive/Anxiety Symptoms and Emotion Recognition Abilities 12
- 1.3.2. Adult Alexithymia's Relationship with Emotion Recognition Abilities 15

1.4. The Distinctiveness of the TAS-20 Subfactors from Depressive Symptoms 16

1.5. Aims of this Body of Research in Adult Populations 18

1.6. Introduction to Alexithymia in Children 19
- 1.6.1. The Importance of Alexithymia Research in Children 19
- 1.6.2. Correlates of Child Alexithymia 25
- 1.6.3. Current Trends and Limitations of the Previous Literature in Children 26

1.7. Addressing the Issue of Child Alexithymia Measures 29

1.8. Is Childhood Alexithymia Related to Emotion Dysregulation? 31
1.8.1. Childhood Depressive Symptoms' Relationship with Alexithymia and Emotion Dysregulation 32

1.9. The Behavioural Correlates of Child Alexithymia: An Emotion Recognition Perspective 34
1.9.1. The Associations Between Childhood Depressive/Anxiety Symptoms and Emotion Recognition Abilities 35

1.10. Aims of this Body of Research in Child Populations 37

1.11. Thesis Overview 37

Chapter 2: Childhood Trauma, Depressive Symptoms and Anxiety: The Mediating Role of Alexithymia **41**

2.1. Introduction 41

2.2. Methods 44

2.3. Results 48

2.4. Discussion 57

Chapter 3: Identifying the Behavioural Correlates of Alexithymia in Adults: Findings from an Emotional Expression Morph **63**

3.1. Introduction 63

3.2. Methods 67

3.3. Results 74

3.4. Discussion 82

Chapter 4: The Unique Contributions of the TAS-20 Subfactors and Their Distinctiveness from Depressive/Anxiety Symptoms **93**

4.1. Introduction 93

4.2. Methods 95

4.3. Results 99

4.4. Discussion 107

Chapter 5: The Psychometric Properties of a Parent-Report Measure of Alexithymia in Children: the Alexithymia Questionnaire for Children – Parent (AQC-P) **115**

5.1. Introduction 115

5.2. Methods 117

5.3. Results 122

5.4. Discussion 129

Chapter 6: The Mediating Role of Child Alexithymia on the Relationship Between Maladaptive Emotion Regulation and Early-Life Alexithymia **133**

6.1. Introduction 133

6.2. Methods 136

6.3. Results 138

6.4. Discussion 146

Chapter 7: Identifying the Behavioural Correlates of Alexithymia in Children: Findings from an Emotional Expression Morph Paradigm **153**

7.1. Introduction 153

7.2. Methods 158

7.3. Results 163

7.4. Discussion 174

Chapter 8: Summary of Results and General Conclusion **183**

8.1. Introduction 183

8.2. Recap of the Findings in Adults 183

8.3. Recap of the Findings in Children 185

8.4. The Neurobiological Basis of Alexithymia: the Role of Insular Cortex Abnormalities 189

8.5. A Case for Mindfulness-Based Interventions: a Possible Amelioration Strategy for Alexithymia 192

8.6. Future Directions in Adults 195

8.6.1. DIF-Specific Mindfulness Training 195
8.6.2. Interoceptive Awareness Treatments: Floatation-REST 196
8.6.3. The Psychophysiological Correlates of Alexithymia 197

8.7. Future Directions in Children 198

8.7.1. Mindfulness Training in Children with Alexithymia 198
8.7.2. Neuroimaging Studies in Children with Alexithymia 199
8.7.3. Longitudinal Studies in Children with Alexithymia 199

8.8. Limitations of this Body of Research 200

8.8.1. Sample Limitations in Adults 200
8.8.2. Sample Limitations in Children 201
8.8.3. Methodological Limitations in Adults 202
8.8.4. Methodological Limitations in Children 202

8.9. Concluding Remarks 204

References **205**
Appendices **270**

List of Tables and Figures

Tables

1.1	Summary of the TAS-20 and its subfactors.	3
1.2	Summary of articles identified in a literature search conducted on PubMed.	20
1.3	Literature review on previous papers investigating alexithymia in children.	21
2.1	Key variable score demographics and distributions of alexithymia, depressive/anxiety symptoms and childhood trauma.	50
2.2	Correlation matrix of the key variables' total and subfactor scores and participant age.	52
2.3	Dual-mediation analysis with HADS-D score as the dependant variable, correcting for participant age, gender and educational attainment.	54
2.4	Dual-mediation analyses with HADS-A score as the dependant variable while correcting for participant age, gender and highest educational attainment.	56
3.1	Means, standard deviations and score ranges of the key psychometric measures.	75
3.2	Average performance on the Emotional Expression Multimorph Task.	76
3.3	Summary of findings from correlations and multivariate general linear models on EEMT average frame response scores, controlling for participant demographics.	81
3.4	Multivariate linear regression analysis with happy response frame score as the dependant variable.	82
4.1	Means, standard deviations and ranges for key variables and their subfactors.	101
4.2	Correlational analyses between DIF and DDF/EOT, with Fishers r-to-z transformations.	102
4.3	Multivariate linear regression analyses with DIF as the dependant variable.	103
4.4	Multivariate linear regression analysis with DDF/EOT as the dependant variable.	104
4.5	Exploratory factor analysis on DIF and HADS – Depression items: principal component analysis with an oblimin rotation.	106

4.6	Exploratory factor analysis on DIF and HADS – Anxiety items: principal component analysis with an oblimin rotation.	108
5.1	Means, standard deviations and ranges of the key variables.	123
5.2	Cronbach alphas and inter-item correlations of the AQC/AQC-P total and subfactor scores.	124
5.3	Correlations between the AQC, AQC-P and external measures.	125
5.4	Multiple linear regression analysis with AQC scores as the dependant variable.	126
5.5	Multiple regression analysis with AQC-P scores as the dependant variable.	127
5.6	Confirmatory factor analyses of the two and three factor solutions on the AQC-P.	128
6.1	Means, standard deviations and Cronbach alphas of total AQC, AQC-P, DSRS and ERQ-CA scores.	139
6.2	Mediation analyses with total ERQ-CA score as the independent variable, DSRS score as the dependant variable and AQC/AQC-P as the mediator, controlling for participant developmental difficulties in model 2.	142
6.3	Correlational matrix of AQC, ACQ-P, ERQ-CA and DSRS total and subfactor scores.	143
6.4	Mediation analyses with CR score as the independent variable, DSRS score as the dependant variable and AQC subfactor DDF as the mediator, controlling for participant developmental difficulties.	145
6.5	Mediation analyses with ES score as the independent variable, DSRS score as the dependant variable and AQC subfactor EOT as the mediator.	145
6.6	Mediation analyses with CR score as the independent variable, DSRS score as the dependant variable and AQC-P subfactors DIF, DDF and EOT as the mediators, controlling for participant developmental difficulties.	147
7.1	Means, standard deviations and ranges of the key measures.	164
7.2	Average performance on the Emotional Expression Multimorph Task – Child.	165
7.3	Hierarchical multivariate linear model of the effect of alexithymia, depressive symptoms and anxiety on sad response frame scores.	169
7.4	Means, standard deviations and ranges of the key variables.	170

7.5 Multivariate linear model of the effect of parent-rated alexithymia, autistic traits and internalising behaviour on happy response frame scores. 174
7.6 Summary of the relationships between the key variables and EEMT task performance. 175
8.1 Summary of findings in adults. 186
8.2 Summary of findings in children. 188

Figures

2.1 Hypothetical mediation model, with childhood trauma as the independent variable, depressive/anxiety symptoms as the dependant variable and alexithymia as the mediator. 44
3.1 Screenshots of the EEMT, demonstrating task procedure. 73
6.1 Hypothetical mediation model, with emotion regulation as the independent variable, depressive symptoms as the dependant variable and alexithymia as the mediator. 135
7.1 Screenshots of the EEMT-C, demonstrating task procedure. 162

List of Abbreviations

TAS-20	Toronto Alexithymia Scale – 20
DIF	Difficulty Identifying Feelings
DDF	Difficulty Describing Feelings
EOT	Externally Oriented Thinking
CTQ	Childhood Trauma Questionnaire
HADS	Hospital Anxiety and Depression Scale
BDI	Beck's Depression Inventory
STAI	State Trait Anxiety Inventory
AQ	Autism-Spectrum Quotient
PCL-C	PTSD Checklist – Civilian Version
AQC	Alexithymia Questionnaire for Children
ACQ-P	Alexithymia Questionnaire for Children – Parent
SDQ	Strengths and Difficulties Questionnaire
EQ	Empathy Quotient
DSRS	Depression Self-Rated Scale
AQ-C	Autism-Spectrum Quotient – Child
ERQ-CA	Emotion Regulation Questionnaire – Children and Adolescents
EEMT	Emotion Expression Multimorph Task
OA	Overall Accuracy
FRA	First Response Accuracy
AFR	Average Frame Response

Chapter 1

Introduction and Overview of Alexithymia in Adult and Child Populations

1.1. Introduction to Alexithymia in Adults

Alexithymia is a subclinical psychological phenomenon characterised by both affective and cognitive deficits in the awareness of one's own emotional states (Taylor, 1984). More specifically, individuals with heightened alexithymic traits typically exhibit difficulties in identifying and articulating their feelings, as well as a reduction in introspective thought. The term alexithymia was first coined by the psychoanalyst Peter Sifneos (1973), and was derived from his native Greek (*a*; "not", *lexis*, "speech" and *thȳmós*, "emotions"). Since its seminal definition in the 1970's, there has been an exponential growth in alexithymia research aiming to identify the aetiology, epidemiology and trans-diagnostic comorbidity of alexithymic traits. However, the majority of the previous investigations have been conducted in individuals with psychiatric conditions. As such, the antecedents and consequences of alexithymia are not well understood in nonclinical populations. The main aim of this body of research was to therefore gain a better understanding of alexithymia's psychometric and behavioural correlates in individuals from the general population.

1.1.1. *The History of the Alexithymia Construct*

While the term 'alexithymia' was first applied by Sifneos, the psychological construct has its origins in the clinical observations of psychosomatic patients by Ruesch (1948). Ruesch

described his patients has having an “infantile personality”, as they demonstrated a child-like understanding of their emotions and often failed to describe their feelings succinctly. Rather, he observed the patients depending on external cues around them to determine what the appropriate response was during psychotherapeutic sessions. Considering psychoanalysis was the pivotal school of thought in the mid-20th century, much of the early literature on alexithymia’s aetiology centred on Freudian interpretations. Based on Freud’s belief the biological basis of psychoanalysis would be eventually understood (Lane, Weihs, Herring, Hishaw & Smith, 2015), the “specificity theory” was coined by Franz Alexander in order to explain Ruesch’s observations on psychosomatic patients. Alexander speculated that psychosomatic illnesses (e.g., peptic ulcers, fibromyalgia and asthma) were underpinned and exacerbated by “specific unconscious conflict” (Alexander, 1950). In other words, it was theorised the patients’ poor physical health was explained, at least in part, by unconscious difficulties in their emotional processing and understanding. In order to objectively test Alexander’s theory of specific unconscious conflict, Sifneos collected interviews from individuals suffering from the illnesses described by Alexander. From the data collected, Sifneos refuted the notion that the psychosomatic patients were experiencing “unconscious conflict”; rather, he suggested they experienced difficulties describing and identifying the emotions they experienced on a day-to-day basis. In light of this, Sifneos introduced the concept of ‘alexithymia’ to capture the emotional understanding deficits he observed in his patients.

1.1.2. *Measures of Alexithymia in Adults*

While clinical observations of alexithymic traits in psychosomatic patients acted as a basis for early research, it was not until the mid-1980’s that an empirical measurement of alexithymia was developed. Using Sifneos’ descriptions of the patients’ behaviour, Taylor developed a self-reported assessment tool in order to quantify alexithymic traits. Dubbed the

Toronto Alexithymia Scale – 26 (TAS-26) the instrument assessed four components that aimed to capture the global alexithymia construct, with two subfactors pertaining to *affective* alexithymia (i.e., 'Difficulties Identifying Feelings', henceforth 'DIF' and 'Difficulties Describing Feelings', henceforth 'DDF') and two subfactors pertaining to *cognitive* alexithymia (i.e., 'Externally Oriented Thinking', henceforth 'EOT' and 'Diminished Fantasy Life'; henceforth 'DFL'). While the measure was innovative in providing a more objective measure of an individual's alexithymic traits, the early version of the TAS had numerous methodological shortcomings. For example, the subfactor DFL was found to show poor psychometric properties (Bagby, Parker & Taylor, 1994) and correlated negatively with the other subfactors (Haviland, Hendryx, Cummings & Shaw, 1991). A revised edition of the TAS-26 was therefore established removing the DFL subfactor, giving way to the Toronto Alexithymia Scale-20 (henceforth TAS-20; Bagby et al., 1994; see Table 1.1 for summary).

Table 1.1.

Summary of the TAS-20 and its subfactors.

	Subfactor	Acronym	Example Item
Affective Alexithymia	Difficulties Identifying Feelings	'DIF'	*"When I am upset, I don't know if I am sad, frightened or angry"*
	Difficulties Describing Feelings	'DDF'	*"It is difficult for me to find the right words to describe my feelings"*
Cognitive Alexithymia	Externally Oriented Thinking	'EOT'	*"I find examination of my feelings useful in solving personal problems"*

While other self-reported (e.g., California Q-set, Haviland & Reise, 1996; Bermond-Vorst Alexithymia Questionnaire, Vorst & Bermond, 2001), peer-reported (e.g., Observer Alexithymia Scale; Haviland, Warren & Riggs, 2000) and qualitative (e.g., Toronto Structured Interview for Alexithymia; Bagby, Taylor, Parker & Dickens, 2006) measures

have been developed, to date, the TAS-20 remains the prevailing assessment tool used to assess alexithymic traits. The TAS-20 has been widely administered in clinical (e.g., Saarijärvi, Salminen & Toikka, 2006) populations, with a small subset of previous investigations assessing alexithymia in the general population (Honkalampi, Hintikka, Tanskanen, Lehtonen & Viinamäki, 2000). Furthermore, the total TAS-20 has demonstrated good internal consistency and stability across small (n = 71; Richards, Fortune, Griffiths & Main, 2005) and very large (n = 1933; Parker, Taylor & Bagby, 2003) sample sizes.

1.1.4. *The Importance of Alexithymia Research*

When administering the TAS-20/26, it has been found between 8.9% (Franz et al., 2008) and 19% (Parker, Taylor & Bagby, 1989) of the general population could be identified as alexithymic, with most agreeing a prevalence rate of ~10% (Mattila, Salminen, Nummi, & Joukamaa, 2006). As it is a relatively common psychological phenomenon, there has been a growing interest in assessing the negative psychological consequences of alexithymia in the general population. For example, alexithymia has been found to be associated with poorer utilisation of adaptive emotion regulation strategies (Swart, Kortekaas & Aleman, 2009), increased prevalence of subclinical depressive symptoms (Honkalampi et al., 2000), difficulties maintaining interpersonal relationships (Qualter, Quinton, Wagner & Brown, 2009), higher rates of non-suicidal self-injury (Borrill, Fox, Flynn & Roger, 2009) and suicide attempt risk (see Davey, Halberstaht, Bell & Collings, 2018 for review) in otherwise healthy individuals. Alexithymia has been found to have adverse health consequences, with marked alexithymic traits associated with substance misuse (Helmers & Mente, 1999), somatic complaints (Panayiotou et al., 2015) and decreased cardiovascular health (Tolmunen, Lehto, Heliste, Kurl & Kauhanen, 2010).

Alexithymia is also commonly observed in psychiatric populations, with previous investigations finding prevalence rates of between 28% and 85% (Cox, Swinson, Shulman & Bourdeau, 1995; Hill, Berthoz & Frith, 2004). Alexithymia itself is not currently recognised as a psychiatric illness (Ricciardi, Demartini, Fotopoulou & Edwards, 2015). Despite this, there has been an extensive focus on investigating the consequences of comorbid alexithymic traits within populations with mental health issues as it may exacerbate the severity of many psychiatric conditions (Bird et al., 2010; Nicolò et al., 2011; Evren & Evren, 2005). Depression and anxiety are perhaps two of the most well-known psychiatric illnesses associated with alexithymia, with authors positing that alexithymic traits may predispose individuals to develop mood and anxiety disorders (Marchesi, Brusamonti & Maggini, 2000; Tani et al., 2004). Furthermore, it has been estimated one in two individuals with major depressive disorder (MDD) are alexithymic (Kim et al., 2008). Considering alexithymic traits limit an individual's ability to introspect and elaborate on their feelings, this presents psychotherapists with a challenge during treatment. Elevated alexithymic traits have been found to negatively impact on therapeutic engagement (Rasting, Brosig & Beutel, 2005) and treatment outcome (Suslow, Rufer, Kersting & Guenther, 2016) in MDD patients. Furthermore, previous studies have also identified a significant resistance of alexithymic traits during the treatment of depressive illness both to psychotherapeutic (see Ogrodniczuk, Piper & Joyce, 2011 for review) and pharmacotherapeutic (Özsahin, Uzun, Cansever & Gulcat, 2003) strategies. Therefore, the presence of heightened alexithymic traits may limit the improvement of symptomology during treatment. However, to date, no preventative or amelioration strategies have been developed specifically targeting elevated alexithymic traits, either in clinical or at-risk individuals. Additionally, there have been calls to identify which of the alexithymia constructs (DIF, DDF and/or EOT) may be the most important to target during potential treatment.

1.1.5. *The Temporal Stability of Alexithymia*

The stability of an individual's alexithymic traits over time has been previously contested. There has been some speculation alexithymia is a state-dependant psychological construct that fluctuates in response to psychological stress and psychiatric illness severity. For example, a minority of authors have identified a significant improvement of alexithymic traits in response to psychological intervention strategies during the treatment of substance abuse disorders (de Haan et al., 2012) and cancer (Porcelli, Tulpani, Micco, Spedicato & Maiello, 2011). However, the majority of studies in clinical populations have disputed this notion, with authors identifying relative and absolute stability of alexithymia in clinical individuals with depressive illness (Saarijärvi et al., 2006), alcohol dependence (Thorberg et al., 2016), disordered eating (Speranza, Loas, Wallier & Corcos, 2007), somatic complaints (de Gucht, 2003) and gastrointestinal-specific anxiety (Porcelli, de Carne & Leandro, 2017). Likewise, investigations in the general population have identified a relative stability of alexithymia in adults (Salminen, Saarijärvi, Toikka, Kauhanen & Äärelä, 2006); Hiirola et al., 2017). In an 11-year longitudinal study conducted by Tolmunen and colleagues (2011), changes in TAS-20 score over time were considered non-significant, with an effect size of d = .09. Alexithymia has also been found to be stable in younger generations. For example, a 4-year longitudinal study conducted in adolescents identified a negligible change in TAS-20 score from baseline to follow-up assessment (Karukivi, Pölönen, Vahlberg, Saikkonen & Saarijärvi, 2014). As such, the current consensus is that alexithymia is an enduring personality trait that prevails regardless of potentially co-occurring psychopathological symptoms.

1.1.6. *Current Trends and Limitations of the Previous Literature in Adults*

As discussed earlier, much of the early studies investigating the development of alexithymia were based on Freudian interpretations. However, as criticism grew regarding the psychoanalytical interpretation of life experiences, researchers turned to a more objective, atheoretical framework to investigate the potential role of negative early-life experiences on alexithymia's aetiology. Growing efforts have been made in identifying the possible link between childhood adversity and alexithymic traits, predominately underpinned by the works of Bowlby (1958) and Krystal (1978). Considering childhood adversity may be an antecedent of many later-life psychiatric illnesses, it has been of interest to ascertain if alexithymia follows similar patterns of associations. However, to date, it remains unknown if the possible significant relationship between traumatic childhood experiences and later-life alexithymia remains after correcting for potentially comorbid depressive/anxiety symptoms.

There has been a recent paradigm shift in the assessment of alexithymia. While much of the previous literature has focused on investigating alexithymia at the concept level, a more recent approach has been to identify the behavioural correlates of alexithymic traits. Early behavioural studies predominantly administered the Rorschach Inkblot Test as an assessment of alexithymic tendencies in individuals (Acklin & Bernat, 1987). Over time, more up-to-date assessment tools have been developed to assess the behavioural correlates of alexithymia. For example, there has been a growing interest in identifying the possible psychosocial consequences of alexithymic traits, notably via emotion recognition paradigms. However, much of the previous studies have been limited by rudimentary methodologies, such as the presentation of fully-expressed, static stimuli for unlimited time periods (see Grynberg et al., 2012 for review). As such, identifying the potential subtle emotional processing deficits in alexithymic individuals has remained largely understudied. Furthermore, if alexithymic traits remain a significant predictor of emotional processing

deficits after controlling for co-occurring depressive/anxiety symptoms has not been investigated.

Interest has grown in assessing the role of alexithymia in the established consequences of adult psychopathology. For instance, underlying alexithymic traits have been found to explain many of the psychosocial deficits associated with autism spectrum conditions (ASC), such as poorer recognition of emotional facial expressions (Cook, Brewer, Shah & Bird, 2013) decreased empathic brain responses (Bird et al., 2010) and shorter gaze-fixations towards emotive stimuli (Bird, Press & Richardson, 2011). Furthermore, a recent study conducted by Di Tella and colleagues (2018) concluded underlying alexithymic traits, not fibromyalgia, explain a significant increase in pain attribution towards angry facial expressions. While these results are promising, the role of alexithymia in the known sequelae of other psychopathological symptoms, such as depression and/or anxiety, remains poorly understood.

Lastly, recent works conducted by Murphy and colleagues (Murphy, Brewer, Hobson, Catmur & Bird, 2018; Murphy, Brewer, Catmur & Bird, 2017) have highlighted the possible link between alexithymia and impaired interoceptive awareness. Interoception refers to the ability to be aware of one's emotional and physical state. It has been suggested interoceptive awareness deficits may be associated with the 'psychopathology-', or, 'p-factor', speculated to underpin the development and maintenance of psychiatric illnesses (Caspi et al., 2014; Murphy et al., 2017). As such, there have been calls to identify which of the alexithymia constructs, DIF, DDF and/or EOT constitute as 'core' alexithymia and may act as a proxy-measure for interoceptive deficits. To date, this has yet to be investigated.

The vast majority of the previous studies discussed above have been conducted in adults with psychiatric conditions. While assessing alexithymia in those with clinical levels of psychopathological symptoms has proved useful in identifying the correlates of co-morbid

alexithymic traits, there are some limitations. As discussed earlier, alexithymia is known to fall on a wide spectrum of severity even within healthy individuals (Honkalampi et al., 2000). As clinical populations may represent only the extreme end of this continuum, findings from these individuals may not be extrapolated to the wider population. Therefore, by assessing the psychometric and behavioural correlates of alexithymia in the general public, a greater understanding on the adverse consequences of alexithymic traits in otherwise healthy individuals can be attained.

1.2. The Influence of Childhood Adversity on the Development of Alexithymia

Childhood adversity, or childhood trauma, is often divided into two distinctive traumata; neglect and abuse (Bernstein et al., 2003). Neglect is considered the most prevalent form of childhood maltreatment and refers to the persistent failure of the caregiver(s) in meeting their child's basic needs, including satisfactory health care, nutrition, housing, clothing and emotional support (Hildyard & Wolfe, 2002). In the UK, rates of severe physical and/or emotional neglect by the child's guardian(s) have been estimated at 9.8% for 11 to 17 year olds (Bentley et al., 2017). In contrast, abuse refers to the deliberate acts of maltreatment that may involve a child's subjection to sexually, psychologically and/or physically abusive behaviour from their caregiver(s). Rates of emotional, physical and sexual abuse from the child's guardian(s) have been estimated at 13.4%, 6.9% and 4.8% in 11 to 17 year olds, respectively (Bentley et al., 2017). Experiences of neglect and abuse have been associated with negative psychosocial consequences, such as poor emotional intelligence, increased risk of suicidal thoughts and the development of psychopathology later in life (Kim & Cicchetti, 2010).

A growing body of evidence suggests that the experience of early traumatic events may elicit disturbances in cognitive-affective functioning, notably poor emotional understanding (Berenbaum, 1996; Brown, Fite, Stone & Bortolato, 2016). One of the earliest

proponents of this notion, Krystal (1978) suggested dysfunctional family environments experienced during childhood may in turn give way to alexithymic tendencies. Supporting this, childhood adversity has been found to be associated with alexithymia in both those who met criteria for psychiatric illness (Demers, Olson, Crowley, Rauch & Rosso, 2015; Yilmaz et al., 2016) and those who have not (Mazzeo & Espelage, 2002). While there is a substantial literature highlighting the link between global childhood maltreatment and alexithymia, a small proportion of these studies have aimed to identify the specific traumata responsible for later-life alexithymia, yielding differing results. The majority of the investigations found no association between a history of sexual abuse and alexithymia (Aust, Härtwig, Heuser, & Bajbouj, 2013; Brown et al., 2016; Paivio & McCulloch, 2004). However, a recent study has challenged this notion, finding alexithymia partially mediates the relationship between child sexual abuse and psychological distress, as assessed by the Kessler Psychological Distress Scale (Kessler et al., 2002; Hébert, Boisjoli, Blais & Oussaïd, 2018). Furthermore, the role of emotional and physical abuse has been investigated, with some authors finding a significant association (Mazzeo & Espelage, 2002; Paivio & McCulloch, 2004), while others did not (Aust et al., 2013; Evren & Evren, 2005; Yilmaz et al., 2016). However, the majority of the authors concluded that emotional neglect is the most influential traumata that may act as a risk factor for developing alexithymia (Aust et al., 2013; Brown et al., 2016). It has been proposed that a child's emotional competence is directly related to how secure their attachment style is with their primary caregiver (Bowlby, 1958; Thompson, 2008). Not receiving emotional nurturing may negatively impact on the child's emotional understanding, potentially leading to the development of alexithymic tendencies and psychopathological symptoms in later life (Montebarocci, Codispoti, Baldaro & Rossi, 2004).

Traumatic experiences in early life have also been associated with the onset, severity and chronicity of many psychiatric illnesses, in particular disordered mood and anxiety

(Gibb, Chelminski & Zimmerman, 2007). Consequently, studies have identified a dose-dependent relationship between the number of early traumatic events and suicide attempts, the presence of depressive symptoms across the lifetime and episodes of anxiety (Huang, Schwandt, Ramchandani, George & Heilig, 2012; Edwards, Holden, Felitti & Anda, 2003). While the majority of the literature has focused on global maltreatment during childhood, there is some evidence to suggest the *type* of traumata experienced has varying effects on later life psychopathology. For example, depressive illness is considered one of the most common psychological sequelae of emotional trauma, notably emotional neglect (Hovens, Giltay, van Hemert & Pennix, 2015). In contrast, it has been reported that experiencing physical and sexual abuse is associated with a 2.03 – 3.83 fold risk increase in developing anxiety disorders, particularly panic disorder, social and general anxiety (Cougle, Timpano, Sachs-Ericsson, Keough & Riccardi, 2010; see Lindert et al., 2014 for review).

While the previous investigations have garnered promising results, the association between childhood traumatic experiences and alexithymia remains little understood in individuals from the general populace. Furthermore, it has yet to be investigated if alexithymia plays a significant role in the relationship between childhood adversity and later-life depressive/anxiety symptoms.

1.3. The Behavioural Correlates of Alexithymia: An Emotion Recognition Perspective

Within adult populations, there is an extensive body of literature investigating the relationship between psychopathology and impaired emotion recognition, notably in individuals with schizophrenia (Averbeck, Bobin, Evans & Shergill, 2012), bipolar disorder (Malhi et al., 2007), borderline personality disorder (Daros, Zakzanis & Ruocco, 2013), anxiety (Stein, Goldin, Sareen, Zorrilla & Brown, 2002) and depressive illness (Dalili, Penton-Voak, Harmer & Munafò, 2015). Understanding the influence of emotion recognition deficits is of particular importance in depression and anxiety, as it is associated with a

decrease in social support, difficulties in maintaining interpersonal relationships and life satisfaction in those with mood disorders (Carton et al., 1999). More importantly, the misidentification of others' emotional expressions may contribute to the maintenance and chronicity of anxiety and depressive illness (Foland-Ross & Gotlib, 2012). While most of the previous studies have been conducted in clinical samples, similar maladaptive emotion recognition skills have been identified in healthy adults with elevated depressive and anxiety symptoms (Lazarov, Ben-Zion, Shamai, Pine & Bar-Haim, 2018). It therefore appears that emotion recognition difficulties may fall on a wide spectrum of severity, across clinical and nonclinical populations. Despite these promising findings in clinical and healthy adult samples, the potential contribution of co-occurring alexithymic traits on emotion recognition and processing has remained understudied.

1.3.1. *The Associations between Adult Depressive/Anxiety Symptoms and Emotion Recognition Abilities*

Prominent cognitive theories of mood disorders posit individuals with depression preferentially process negatively valenced stimuli compared to positively valenced stimuli (Beck, 1976; Hallion & Ruscio, 2011). It may therefore be hypothesised that when presented with emotive stimuli, an attentional bias towards the extreme ends of the affect continuum may be detected. That is, a significant attentional bias towards both negative emotions (i.e., sadness) and an attenuation away from positive emotions (i.e., happiness) would be seen in individuals with marked depressive symptoms. Congruent with this notion, much of the previous literature has identified a significant deficit in the recognition of happiness in depressed individuals across studies using numerous methodologies, such as eye-tracking (Duque & Vázquez, 2015), emotion-labelling (Gaebel & Wölwer, 1992) and schematic face (Suslow, Junghanns & Arolt, 2001) paradigms. Furthermore, a recent meta-analysis of 22 emotion-labelling paradigms found significant recognition impairment across five of the six

basic human emotions (i.e., happiness, disgust, surprise, anger and fear; Ekman 1992) in MDD patients, with effect sizes between *g* = -.420 to *g* = -.170 (Dalili et al., 2015). In contrast, the authors concluded increased recognition of sadness to be the least robust finding, with an overall effect size of *g* = -.009. Supporting this, previous findings on the association between MDD and a cognitive bias towards sad emotional stimuli have been heterogeneous. For example, a significant attentional bias towards sad expression stimuli in depressed patients compared to controls has been previously identified (Gotlib, Krasnoperova, Yue & Joormann, 2004). Conversely, in a recall task conducted by Ridout and colleagues (2009), MDD outpatients did not demonstrate an enhanced emotional memory bias towards sad facial stimuli when compared to a healthy control sample.

While the majority of the previous literature has been conducted in patients with MDD, some effort has been made to ascertain if similar biases can be detected in healthy individuals. A minority of authors have found no significant influence of elevated depressive symptoms on emotion recognition abilities (Clark, Chiu, Diaz & Goghari, 2014), whereas other studies have identified similar patterns of associations in nonclinical populations (Laeger et al., 2012; Lazarov et al., 2018). For example, in a study conducted by Lazarov and colleagues (2018), nonclinical university students were compared with a sample of MDD patients on an emotional expression free-gazing task. Students with marked depressive symptoms were found to show similar gaze patterns to the clinical sample, with significantly longer fixations on the static sad expressions compared to the students with minimal depressive symptoms. Conversely, those with no depressive symptoms were found to have significantly longer fixations on the happy expressions compared to the other two groups. The authors concluded that the cognitive bias towards positive and negative affect falls on a continuum across depression symptomology, from nonclinical to clinical levels of severity. While the results are promising, the authors did not control for other potential confounders

that may have influenced the participants' emotion recognition skills, such as co-occurring alexithymic traits or anxiety symptoms.

Anxiety disorders are also associated with maladaptive cognitive biases towards emotional expressions. Theorists have posited anxious individuals exhibit a heightened perception of danger, caused by amygdala over-activation (Eysenck & Calvo, 1992; Dalgleish, Moradi, Taghavi, Neshat-Doost & Yule, 2001). Therefore, it may be predicted anxious individuals focus their attention to both threatening (i.e., angry) and threatened (i.e., fearful) emotional expressions significantly more than healthy controls. This hypervigilance has been seen across numerous behavioural studies (Wieser, Pauli, Weyers, Alpers, & Mühlberger, 2009; Chalmers, Quintana, Abbott & Kemp, 2014; McClure et al., 2007). For example, clinically anxious adults have been found to have significant attentional biases towards angry (Carré et al., 2013) and fearful (Mogg, Garner, Bradley, 2007) faces compared to healthy controls. Furthermore, previous neuroimaging studies have identified significantly increased amygdala activation in response towards threatened/threatening stimuli in clinically anxious patients (Stein et al., 2002), consistent with the theory put forward by Eysenck and Calvo (1992).

Nonclinical populations with high trait anxiety have also been found to show exaggerated responses to potentially threatening stimuli. Similar to clinically anxious individuals, the majority of the previous studies in healthy populations have identified a significant attentional bias towards angry (Carré et al., 2013; Rossignol, Anselme, Vermeulen, Philippot, & Campanella, 2007) and fearful (Surcinelli, Codispoti, Montebarocci, Rossi & Baldaro, 2006) faces. It therefore appears that, similar to the findings of Lazarov and colleagues (2018), the significant hypervigilance towards threatening/threatened stimuli can be detected across the anxiety symptom severity spectrum.

Depression and anxiety are frequently comorbid, both in clinical (Sartorius, Üstün, Lecrubier & Wittchen, 1996) and nonclinical (Pirkola et al., 2005) populations. While sharing similar symptomology, the two psychological constructs may present unique influences on an individual's emotion recognition abilities. From a theoretical perspective, Beck's (1976) content-specificity hypothesis suggests anxious and depressed individuals show cognitive biases towards the emotional stimuli pertinent to the cognitive schema that underpin the psychiatric illness (Beck, 1976; Joormann & Gotlib; 2006). That is, anxiety should be more associated with fear/anger; depression with happiness/sadness. While the majority of the literature discussed above have found partial support for Beck's theory, much of the previous investigations have failed to assess both depressive and anxiety symptoms concurrently in the tested samples. As such, the potential influences of co-occurring depressive and anxiety symptoms on emotional processing remains unclear. Furthermore, a consistent limitation of the previous studies has been the failure to assess other psychological constructs that might influence emotion recognition, such as alexithymia.

1.3.2. *Adult Alexithymia's Relationship with Emotion Recognition Abilities*

While self-evaluative measures are predominantly used in alexithymia research, efforts have been made to identify alexithymia's behavioural correlates, notably using emotion recognition tasks. An overall deficit in emotion recognition abilities has been found in the majority of clinical adult studies (see Grynberg et al., 2012 for review), even after controlling for depression and anxiety (Pedrosa Gil et al., 2009). It may be speculated that, considering alexithymia's significant associations with depression and anxiety, similar biases towards emotive stimuli may be observed in alexithymic individuals. While a small proportion of previous studies have investigated this, the results have not been consistent. For example, alexithymic individuals were found to have increased brain activity when presented with fearful and angry faces (Mériau, Wartenburger, Kazzer, Prehen & Lammers, 2006) and

decreased activity during the processing of happy faces (Kano et al; 2003; Reker et al., 2010). In contrast, other authors have identified no significant effect of alexithymia on the decreased recognition of emotional expressions (Lundh & Simonsson-Sarnecki, 2002; Mann, Wise, Trinidad & Kohanski, 1995). However, the majority of these studies failed to assess depressive and/or anxiety symptoms in their tested populations. As both psychological phenomena have been found to significantly influence emotion expression processing, it remains unclear if the authors' findings were exclusively explained by alexithymia. To examine this, further research is required to measure alexithymia, depressive and anxiety symptoms in tandem during the administration of emotion recognition paradigms.

1.4. The Distinctiveness of the TAS-20 Subfactors from Depressive Symptoms

Uncertainty still remains regarding alexithymia's distinctiveness from other symptoms of psychopathology, most notably depressive symptoms. Both psychological constructs are characterised by disturbances in cognitive-affective functioning (Taylor, Bagby & Parker, 1999), impacting on an individual's ability to effectively regulate the emotions experienced in everyday life. Therefore, alexithymic and depressive symptoms may manifest and present similarly in individuals. As discussed previously in this chapter, alexithymic traits have been found to be highly prevalent in patients with MDD, with approximately half of individuals exhibiting alexithymic tendencies during an acute period of illness (Honkalampi et al., 2004). Furthermore, studies in the general population have found alexithymia and depressive symptoms highly overlap, with correlations between the TAS-20 and depression measures above r = .500 (Honkalampi et al., 2000). In light of this, a significant effort has been made in assessing the uniqueness of the alexithymia construct when measuring depressive symptoms concurrently. Within clinical populations, alexithymia has appeared to exist independently from depression in individuals with a range of conditions including personality disorders (Loas, Baelde & Verrier, 2015), PTSD (Zlotnick, Mattia &

Zimmerman, 2001) and fibromyalgia (Tuzer et al., 2011). In light of this, the majority of authors suggested alexithymia is a prevailing personality trait that may predispose individuals to develop psychiatric illnesses, particularly affective disorders (Marchesi et al., 2000). A minority of studies have challenged this claim, finding the association between alexithymia and disordered eating is fully explained by co-occurring depression (Torres et al., 2015; De Berardis et al., 2017). In one such study, the group difference between participants with bulimia nervosa and healthy controls on TAS-20 scores became non-significant once depressive and anxiety symptoms were corrected for (Eizaguirre, de Cabezon, de Alda, Olariaga & Juaniz, 2004). Similarly, the association between heightened apathy and alexithymia was fully explained by co-occurring depressive symptoms in university students (Ready, Mather, Santorelli & Santospago, 2016). Similar to clinical studies, while a growing body of research in nonclinical populations has found both alexithymia is independent from depressive symptoms (Müller, Bühner & Ellgring, 2003; Lipsanen, Saarijärvi & Lauerma, 2004; Parker, Bagby & Taylor, 1991), some authors have found a significant overlap between the two constructs in healthy individuals (Hintikka, Honkalampi, Lehtonen & Viinamäki, 2001). Considering the heterogeneity of the previous findings, additional research is required in order to establish if alexithymia is distinct from depressive symptoms in the general population. Furthermore, the majority of the previous of authors used the total TAS-20 scores in their analyses (Müller et al., 2003; Lipsanen et al., 2004; Parker et al., 1991; Ready et al., 2016). As such, if significant overlaps emerge between the three TAS-20 subfactor(s) and depressive symptoms remains poorly understood.

There also remains the question to what extent the TAS-20 subfactors themselves are distinct from one another. While the literature is somewhat limited, a recent effort has been made in identifying the unique contributions of DIF, DDF and EOT. For example, externally oriented cognitive styles have been found to be more strongly associated with blunted

empathic behaviour (Grynberg, Luminet, Corneille, Grèzes & Berthoz, 2010; Jonason & Krause, 2013). After controlling for negative affect, an exclusive inverse relationship was found between EOT score and affective theory of mind as measured by the Reading the Mind in the Eyes Test (Demers & Koven, 2015; Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001). Conversely, while EOT has routinely shown a weak to non-significant relationship with depression (Grabe, Spitzer & Freyberger, 2004), DIF and DDF have been found to underpin the association between depressive symptoms and global alexithymia (Vanheule, Desmet, Verhaeghe & Bogaerts, 2007). In a recent meta-analysis conducted by Li and colleagues (2015), the authors concluded from reviewing 19 studies that both DIF and DDF shared moderate correlations with depression severity ($r = .400$ and $r = .300$, respectively) dependant on the psychometric measures administered. There has been some speculation that DIF itself is the main component of this association with psychopathological symptoms, with studies finding DIF is the only significant predictor of global psychopathology (Grabe et al., 2004), major depressive illness severity (Conrad, Wegener, Imbierowicz, Liedtke & Geiser, 2009), the development of anxiety disorders (Karukivi, Vahlberg, Pölönen, Filppu, & Saarijärvi, 2014), the persistence of PTSD symptoms (O'Brien, Gaher, Pope & Smiley, 2008) and suicide ideation (De Berardis et al., 2017). Despite these promising findings, the literature on DIF's unique contributing factor on psychopathology remains limited and it is not clear if similar findings can be identified within a sample from the general population.

1.5. Aims of this Body of Research in Adult Populations

The first set of aims of this body of research are threefold; (i) to investigate the potential influence alexithymic traits have on the relationship between experiences of trauma during childhood and later-life depressive/anxiety symptoms (Chapter 2), (ii) to identify the potential relationship alexithymic traits have on emotion recognition deficits when controlling for potentially co-occurring depressive/anxiety symptoms (Chapter 3) and (iii) if

the TAS-20 construct DIF represents 'core' alexithymia and if it is distinct from depressive/anxiety symptoms (Chapter 4).

1.6. Introduction to Alexithymia in Children

Since the concept was introduced by Sifneos (1973), the majority of the previous studies investigating the aetiology, epidemiology and sequelae of alexithymic traits have focused on clinical adult populations. Over the past two decades there has been a growing, yet modest, attempt to assess alexithymia in children. While the earliest publications on early-life alexithymia were predominately theory-driven (e.g., Luminet, 1994), perhaps the earliest study was conducted by Fukunishi, Yoshida & Wogan (1998) in a sample of Japanese school children with an average age of nine years old. On administering the first empirical child measure of alexithymic traits, the authors identified a small proportion of the sample showed similar emotional understanding difficulties as alexithymic adults. While the study was pivotal in generating interest in child alexithymia, to the author's knowledge, there are currently only 25 publications directly assessing alexithymic traits in children (see Table 1.2 and Table 1.3). Consequently, little is understood regarding the possible adverse psychological consequences of alexithymia during childhood (defined in this body of work as ages 8 to 13). Therefore, the main aim of the last section of this thesis was to identify possible antecedents and sequelae of early-life alexithymic traits.

1.6.1. *The Importance of Alexithymia Research in Children*

It has been estimated around 50% of mental illnesses begin before the age of 14 (Kim-Cohen et al., 2003), with approximately one in ten children under the age of 16 suffering from a diagnosable mental health disorder (Green, McGinnity, Meltzer, Ford & Goodman, 2005). Despite this, a recent review published by the Children's Commissioner found 75% of

Table 1.2.

Summary of articles identified in a literature search conducted on PubMed.

Main topic of article	Number of articles
Alexithymia in psychiatric patients with histories of childhood adversity	61
Alexithymia in child populations	**25**
Alexithymia in healthy populations with histories of childhood adversity	23
Alexithymia in healthy populations without histories of childhood adversity	19
Alexithymia in parents	17
Alexithymia in adolescents	14
Review articles	12
Commentary articles	7
Total	177

Note. Search strategy used: 'child*' [Title/Abstract] AND 'alexithymia' [Title/Abstract] NOT 'adult*' [Title]. Publications not in the English language were excluded. Search conducted 21st July, 2018.

children with mental health issues were not receiving any treatment, particularly children with disordered mood (Children's Commissioner, 2016). It may be speculated that children with overt behavioural difficulties, such as conduct disorder or oppositional defiant disorder, are the easiest to identify (Stormont, Herman & Reinke, 2015). In contrast, some conditions such as depressive symptoms are typically insidious in their development and often go unrecognised by the child's immediate family and their teachers (Hazell, 2002). This is a particular concern as depressive symptoms are known to negatively impact on a child's emotional, psychosocial and cognitive development (Wagner, 2018), and can have long-term consequences well into adulthood (Judd, Akiskal & Paulus, 1997). Consequently, there has been a growing need to identify the antecedents and consequences of mental health issues in childhood. By assessing these, early-intervention strategies may be developed in order to ameliorate the adverse psychological symptoms experienced by at-risk children.

Table 1.3.

Literature review on previous papers investigating alexithymia in children.

Authors	Population	Age range	N	Method	Materials Used	Covariates	Key Findings
Costa et al., 2017	Clinical	3 – 13	37 ASC + 41 controls	Behavioural task + questionnaires	Task: Laboratory Temperament Assessment Battery Measures: AQC-P.	Age, gender	ASC showed greater emotional incoherence than control group. Alexithymia moderated the expression of positive emotions during negative behaviours.
Trevisan et al., 2016	Clinical	7 – 13	17 ASC + 17 controls	Behavioural task + questionnaires	Task: emotionally charged video clips. Measures: AQ, WASI, CAM.	IQ, gender	Abnormalities in the spontaneous production of emotional facial expressions in children with ASC explained fully explained by co-occurring alexithymic traits.
Mishra et al., 2012	Clinical	9 – 18	97 cancer sufferers, 95 siblings + 151 controls	Questionnaire-based	Measures: AQC, non-specified observer rating of alexithymic traits.	None	Alexithymic traits greatest in cancer sufferers.
Donfrancesco et al., 2013	Clinical	8 – 14	50 children with ADHD + 100 controls	Questionnaire-based	Measures: AQC, K-SADS PL, ADHD-RS-P.	None	Total AQC score, DIF and EOT subfactors correlated significantly with symptoms of hyperactivity/impulsivity, however no relationship between alexithymia and inattentiveness symptoms.
Gatta et al., 2011	Clinical	8 – 15	32 headache sufferers, 32 controls	Questionnaire-based	Measures: AQC, TAS-20, ICHD-II.	None	Higher rates of alexithymic traits in children with headaches compared to control group. No significant correlation between child AQC and parent TAS-20 scores.
Fukunishi et al., 2001	Clinical	7 – 10	33 with refectory hematological diseases	Questionnaire-based	Measures: CBC, JASC-TF, PSRC.	None	Children with refractory haematological diseases were more likely to demonstrate alexithymic traits. JASC-TF scores positively correlated with avoidance and emotional numbing due to PTSD.
Griffin et al., 2015	Clinical	8 – 13	25 with ASC, 32 controls	Questionnaire-based	Measures: AQC, CAM-PR, AQ-C, SRS-2.	IQ, gender and age	Alexithymia significantly higher in ASC population. No significant agreement between child and parent reported alexithymic traits was identified.

Authors	Population	Age range	N	Method	Materials	Covariates	Key Findings
Way et al., 2010	Clinical	5 – 17	246 parents of school children with histories of trauma	Scale development	Measures: CAM, JASC-TF, CBC.	Co-occurring behavioural problems	CAM demonstrated good internal consistency and convergent validity with the JASC-TF and CBI.
Savarese et al., 2018	Clinical	6 – 17	28 with C1 inhibitor deficiency, 23 with type 1 diabetes and 25 with rheumatoid arthritis	Questionnaire-based	Measures: AQC, TAS-20, CBC, CLES-C, PH-C.	None	Alexithymia is common in children with chronic disease.
Silvestri et al., 2018	Clinical	Mean age 10.80; range not stated	45 children with a tic disorder, 45	Questionnaire-based	Measures: AQC, TAS-20, CDI, CBC, Y-BOCS, YGTSS.	Gender, mother's education	Neither the AQC nor TAS-20 were predictive of total tic severity after correcting for gender and mother's education.
Housiaux et al., 2010	Clinical	8 – 12	45 children with type 1 diabetes	Psychophysiol-ogical study	Physiological measures: HbA_{1c} values and episodes of hyperglycaemia. Measures: AQC.	Parental marital status and education	Diabetic children, especially those with high DDF, showed an increased risk of poor glycaemic control.
Way et al., 2007	Clinical	n.a	n.a	n.a	n.a	n.a	Review article on the relationship between alexithymia and language impairment in children with histories of trauma. Concluded alexithymic traits are important target for speech-language pathologists who are treating children with language impairments.
Natalucci et al., 2018	Clinical	n.a	n.a	n.a	n.a	n.a	Review article on the relationship between headaches and alexithymia in children and adolescents. Concluded children and adolescents who routinely suffer from headaches show increased alexithymic traits, possibly as a results of incomplete development of emotional competency.

Authors	Population	Age range	N	Method	Materials	Covariates	Key Findings
Bellinger, 2008	Clinical	n.a	n.a	n.a	n.a	n.a	Review article on children with congenital cardiac malformations risk of developing social cognition deficits. Concluded children with heart defects may develop difficulties identifying and describing their emotions and may be at risk of theory of mind deficits.
Jellesma et al., 2009	Nonclinical	9 – 12	35 with many somatic symptoms + 34 with few somatic symptoms	Behavioural task + questionnaires	Task: emotional vignettes Measures: SCL, AQC.	None	Children with multiple somatic complaints reported higher alexithymia, particularly DDF subfactor. Children with higher somatic complaints showed increased negative emotional processing towards emotional vignettes.
Fukunishi et al., 1998	Nonclinical	Mean age 9.00; range not stated	286 parents of school children	Scale development	Measures: JASC-TF, YGPT.	None	JASC-TF demonstrated good internal consistency and high test-retest correlation over 2 months. PASC-TF shared moderate significant correlations with the YGPT.
Rieffe et al., 2006	Nonclinical	9 – 15	740 school children	Scale development	Measures: AQC, SCL, MLC.	None	Total, DIF and DDF scores showed good internal consistency, whereas EOT showed poor internal consistency. Confirmatory factor analysis found a three factor solution for the AQC had adequate fit. Total, DIF and DDF scores significantly associated with SCL score.
Mannarini et al., 2016	Nonclinical	11 – 13	935 school children	Questionnaire-based	Measures: AQC, SDQ.	Gender	Latent class analysis revealed DIF and DDF scores load onto 'internalising' problems subfactor of the SDQ. In contrast, EOT scores load onto 'externalising' problems subfactor of SDQ.
Loas et al., 2017	Nonclinical	9 – 16	80 school children	Questionnaire-based	Measures: AQC.	None	Confirmatory factor analysis revealed the removal of the EOT subfactor from the AQC may have advantages to the measure's reliability. As part of a wider study investigating the psychometric properties of the AQC and TAS-20 in children and adolescents.

Authors	Population	Age range	N	Method	Materials	Covariates	Key Findings
Loas et al., 2010	Nonclinical	9 – 16	740 school children	Questionnaire-based	Measures: AQC.	None	Confirmatory factor analysis revealed a three-factor solution of the AQC met criteria for adequate model fit. However, EOT subfactor showed poor internal consistency.
Rieffe et al., 2010	Nonclinical	10 – 15	579 school children	Questionnaire-based	Measures: AQC, SCL, WRQC.	None	Results from structural equation modelling suggested alexithymia, not negative mood, explains increased internalising symptoms in children and young adolescents.
Van der Veek et al., 2012	Nonclinical	9 – 18	617 school children	Questionnaire-based	Measures: CSI, RCADS, EAQ.	Depressive and anxiety symptoms	Alexithymia measured by proxy using the EAQ. Path analysis identified a non-significant relationship between alexithymia and somatic complaints after correcting for co-occurring depressive/anxiety symptoms.
Cerutti et al., 2018	Nonclinical	10 – 15	709 school children	Questionnaire-based	Measures: DSHI, AQC, IPPA, LSC-R, CDI.	None	Increased DIF and DDF scores associated with NSSI behaviours, stressful events and suicidal ideation. DIF and DDF mediated the quality of attachment to parents/peers on NSSI and suicidal ideation.
Allen et al., 2011	Nonclinical	8 – 17	244 school children and parents	Questionnaire-based	Measures: TAS-20, CDI, CSI.	None	Depression significantly partially mediated relationship between alexithymia and somatisation.
Cerutti et al., 2017	Nonclinical	8 – 15	356 school children	Questionnaire-based	Measures: CSI, FDI, AQC.	Gender, age, DDF and EOT	Alexithymia significantly correlated with somatic symptoms. Somatic symptoms partially mediated the relationship between DIF and functional impairment.

Note. AQC-P: Alexithymia Questionnaire for Children – Parent, AQC: Alexithymia Questionnaire for Children, WASI: Wechsler Abbreviated Scale of Intelligence, CAM: Children's Alexithymia Measure, K-SADS-PL: Kiddie-Schedule for Affective Disorders and Schizophrenia, ADHD-RS-P: ADHD Rating Scale – Parent, DSHI: Delibarate Self-Harm Inventory, IPPA: Inventory of Parent and Peer Attachment, LSC-R: Life Stressor Checklist-Revised, CDI: Child Behaviour Checklist, , CDI: Child Depression Inventory, SCL: Somatic Complaints List, CSI: Children's Somatisation Inventory, TAS-20: Toronto Alexithymia Scale – 20, FDI: Functional Disability Inventory, ICHD-II: International Classification of Headache Disorders – II, CBC: Children's Behaviour Checklist, JASC-TF, Japanese Alexithymia Scale for Children – Teacher Form, PSRC: Posttraumatic Stress Response Checklist, CLES-C: Coddington Life Event Scale – Children, PH-C: Physiological Hyperarousal – Children, Y-BOCS: Yale-Brown Obsessive Compulsive Scale, YGTSS: Yale Global Tic Severity Scale, SDQ: Strengths and Difficulties Questionnaire, YGPT: Yatabe Gilford Personality Test, MLC: Mood List for Children, WRQC: Worry/Rumination Questionnaire for Children, RCADS: Revised Children's Anxiety and Depression Scale, EAQ: Emotional Awareness Scale, n.a: not applicable.

One of the possible antecedents of mental health difficulties may be heightened alexithymic traits. However, little work has been previously done assessing the impact alexithymia has on a child's mental well-being. Considering alexithymia in adulthood has been found to have numerous adverse psychological and health sequelae both in clinical (Bird et al., 2010) and nonclinical (Honkalampi et al., 2000) populations, there may be advantages to assessing alexithymia in preadolescents. For example, if alexithymia was found to be a contributor to the development and maintenance of both internal (e.g., depressive symptoms) and external (e.g., diminished empathy) difficulties, early-intervention strategies may be developed in order to identify and treat at-risk children with elevated alexithymic traits.

1.6.2. *Correlates of Child Alexithymia*

While the literature is scarce, a significant proportion of the previous studies have been conducted in paediatric in-patients, notably children with ASC (Costa, Steffgen & Samson, 2017; Trevisan, Bowering & Birmingham, 2016; Griffin, Lombardo & Auyeung, 2016; De-la-Iglesia & Olivar, 2015). In addition, clinical studies have identified significantly marked alexithymic traits in children with attention deficit hyperactivity disorder (Donfrancesco et al., 2013), tension headaches (Gatta et al., 2011), cancer (Mishra, Maudgal, Theunissen & Rieffe, 2012), somatic complaints (Jellesma, Rieffe, Terowgt & Westenberg, 2009), C1-inhibitor deficiency (Savarese et al., 2018) and type 1 diabetes (Housiaux, Luminet, Van Broeck & Dorchy, 2010). However, while the results are promising, the majority of the investigations mentioned above are preliminary pilot studies. Consequently, the antecedents and consequences of childhood alexithymia in clinical paediatric populations remains little understood.

Furthermore, most of the previous literature in typically developing child populations have aimed to validate child-appropriate assessments of alexithymic traits (Way et al., 2010; Rieffe, Oosterveld & Terwogt, 2006; Fukunishi et al., 1998), with only a small proportion of studies administering additional measures of psychopathological symptoms. For instance, previous community-based studies (Mannarini, Balottin, Toldi & Gatta, 2016; Rieffe et al., 2010) have suggested heightened early-life alexithymic traits may predispose children to develop behavioural problems and internalising symptoms. Furthermore, recent studies have identified a significant association between elevated alexithymic traits, somatic symptomology and suicidal ideation in healthy children (Cerutti et al., 2017; Cerutti, Zuffianò & Spensieri, 2018). However, as potentially co-occurring depressive symptoms were not assessed in these studies, it remains unclear if the findings were a consequence solely of the child's alexithymia. Likewise, the association between child alexithymia and depressive symptoms is currently under explored, with only two studies assessing these psychological phenomena directly (van der Veek, Nobel & Derkx, 2012; Allen, Lu, Tsao Hayes & Zeltzer, 2011). While positive correlations were found in both studies, they were not without significant limitations. For example, van der Veek and colleagues (2012) recruited both children and adolescents in their tested population (ages 7 to 18 years old). Considering this, it is unclear if the authors' findings could be extrapolated to a purely preadolescent sample. Furthermore, Allen and colleagues (2011) administered the adult TAS-20 to their sample of children (see page 31 for more detail on limitations). Therefore, similar to clinical populations, the antecedents and consequences of early-life alexithymia in healthy children is currently understudied.

1.6.3. *Current Trends and Limitations of the Previous Literature in Children*

Due to the preliminary nature of the studies discussed above, substantial research is still required to identify the correlates and consequences of alexithymia in children. A

possible reason for the current lack of research has been the paucity of child-appropriate rating scales. As it has been speculated children may lack the emotional competence to adequately rate their alexithymic traits (Myers & Winters, 2002), there have been calls for the development of a complementary assessment tool for parent(s). While this has recently been achieved (Costa et al., 2017), the authors did not assess either the psychometric validity of the measure, or its congruent validity with a self-reported measure of alexithymia. By confirming the reliability of Costa's (2017) recently published parent measure, it is possible a greater understanding of a child's alexithymic traits may be gained when administering both a peer- and self-report concurrently. However, to date, this has not been investigated.

Currently, there have only been two studies investigating the behavioural correlates of alexithymia in clinical child populations. Trevisan and colleagues (2016) assessed the spontaneous production of facial expressions in children with and without ASC when presented with emotive video clips. The authors concluded the emotional processing deficits were predominantly explained by underlying alexithymic traits, rather than ASC diagnosis. Similarly, Costa and colleagues (2017) identified a significant moderating effect of alexithymia on the expressive incoherence identified in children with ASC. These results are in support of the findings from older populations (Cook et al., 2013; Bird et al., 2010; Bird et al., 2011), in which alexithymia appeared to at least partially explain the known association between ASC and disordered emotional understanding.

While the results have been promising in populations with ASC, the role of alexithymia in the other known antecedents and consequences of early-life psychopathology has been little explored. For example, the contributions of alexithymia in the maintenance of depressive symptoms has yet to be investigated, either in a clinical or nonclinical population. Disordered emotion regulation has been found to be a significant contributing factor to the development of depressive symptoms in childhood (Gullone & Taffe, 2011). Additionally, as

discussed previously in this chapter, alexithymia has been found to be associated with depressive symptoms in preadolescent populations (Allen et al., 2011). Therefore, if underlying alexithymic traits are found to significantly influence the relationship between maladaptive emotion regulation and early-life depressive symptoms, this may have implications into the identification and treatment of at-risk children. However, to date, this has not been assessed.

There has also been a modest attempt to identify the potential behavioural correlates of early-life alexithymia in healthy children, with currently only one study assessing this. Jellesma and colleagues (2009) assessed children with a range of somatic complaints on a mixed-emotions task. Children were asked to read emotive stories and identify which emotion they would feel in the situation presented in the vignette. While children with marked somatic complaints were found to be significantly more alexithymic than children with few somatic complaints, no effect of alexithymia on task performance was identified. It is possible the non-significant effect of alexithymic traits was due to the rudimentary methodology used by the authors. While emotional vignette tasks have been used to identify significant emotional understanding deficits in clinical paediatric samples (e.g., O'Nions et al., 2014; Sharma, Woolfson & Hunter, 2014), these methodologies may be sensitive to ceiling effects in healthy populations. As such, administering more cognitively demanding tasks, such as emotion expression morphing paradigms, may be more useful in detecting subtle behavioural deficits in children without clinically significant psychopathological symptoms. However, to date, the possible effect of early-life alexithymia on the processing of emotional facial expressions has yet to be investigated. Furthermore, no research has examined whether early-life alexithymia remains a significant predictor of emotional processing deficits when other potentially co-occurring psychopathological symptoms (e.g., autistic traits and depressive symptoms) are corrected for.

1.7. Addressing the Issue of Child Alexithymia Measures

In an assessment of the TAS-20's psychometric properties in adolescents, Parker and colleagues (Parker, Eastabrook, Keefer & Wood, 2010) suggested caution should be taken in its administration to adolescent participants, as the measure's level of reading difficulty may reduce its validity in younger populations (Parker et al., 2010). To avoid this possible limitation, previous research in children has primarily utilised the Alexithymia Questionnaire for Children (henceforth, 'AQC'), developed by Rieffe and colleagues (Rieffe et al., 2006). The measure has good internal consistency ($\alpha = .780$; Mishra et al., 2012) and shares construct validity with known correlates of adult alexithymia, in particular autistic traits (Griffin et al., 2016), anxiety (Kaur & Kaur, 2015), substance misuse and psychopathy (Gatta et al., 2014). Based on the TAS-20, the AQC contains the original twenty items reworded into simpler language to facilitate comprehension in young children (Rieffe et al., 2006).

In addition to self-reports, peer-report measures of alexithymic traits have been previously developed. One suggested benefit of administering peer-reports is circumventing the potential paradox of alexithymia auto-evaluative measures. As it is characterized by difficulties in introspective thought, self-report questionnaires evaluating an individual's ability to recognise and describe their emotions may fail to fully measure the severity of their alexithymic traits. Perhaps the most notable peer-report is the Observer Alexithymia Scale (OAS; Haviland et al., 2000), developed for use in adult populations. While the measure has been found to have good internal consistency ($\alpha > .900$, Haviland, Warren, Riggs & Gallacher, 2001), the OAS varies significantly in its conceptual basis of alexithymia compared to the TAS-20. Constructed using the California Q-set Alexithymia Prototype (Haviland & Reise, 1996), the measure conceptualizes alexithymia as consisting of the five subfactors 'distant' (O1) 'uninsightful' (O2), 'somatising' (O3), 'humourless' (O4) and 'rigid' (O5). However, previous investigations have found weak correlations between the

peer report of the OAS and self-report of TAS-20 when the measures are administered in tandem in adult samples (r = .270, Lumley, Gustavson, Partridge, & Labouvie-Vief, 2005; r = .230, Meganck, Vanheule, Desmet, & Inslegers 2010). More recently, the OAS was found to have a non-significant relationship with the AQC, administered to adults with intellectual disabilities (Davies, Frude, Jenkins, Hill & Harding, 2015). These low correlations suggest that this previously developed peer-report has limited utility.

As discussed earlier in this chapter, the possible paradox of alexithymia self-report measures may be further exacerbated in young samples as children may have yet to develop the ability to self-reflect and successfully report their emotions and behaviours (Myers & Winters, 2002). Therefore, supplementing a self-report with a parent-report may be a useful method in assessing child alexithymia severity. Until recently, two attempts have been made to develop a parent-report measure for use in children; the Japanese Alexithymia Scale for Children – Teacher Form (JASC-TF; Fukunishi et al., 1998) and the Children's Alexithymia Measure (CAM; Way et al., 2010). However, there has been relatively little published work in this area. For example, the CAM has only been utilized three times since publication (Griffin et al., 2016; Trevisan et al., 2016; Naste et al., 2017) and has been found to not correlate with the self-reported AQC (r = -.040; Griffin et al., 2016). Similar to the issues of adult peer-report measures, these parent-report scales were not based on well-known self-report scales, such as the AQC/TAS-20.

While there has been a recent attempt to create a parent version of the AQC, the Alexithymia Questionnaire for Children – Parent (henceforth 'AQC-P'; Costa et al., 2017), the authors administered a French and German version of the scale to a relatively small sample (n = 88) and did not assess the measure's psychometric properties other than the total score Cronbach alpha (α = .730; Costa et al., 2017). Most importantly, the self-reported AQC was not administered concurrently in the authors' sample. In sum, the construct validity,

association with known correlates of alexithymia and its level of agreement with the AQC has yet to be investigated.

1.8. Is Childhood Alexithymia Related to Emotion Dysregulation?

The ability to identify, regulate and communicate one's emotions is an integral life skill that develops during early childhood. As early as the first two years of life, toddlers begin to adopt emotion regulation strategies to decrease negative arousal, such as seeking out comforting items or moving away from distressing stimuli (Kopp, 1989). As they progress into childhood, children typically develop a more complex understanding of emotions, facilitating the management, monitoring and modifying of their emotional reactions. This skill is crucial for not only a child's mental health, but maintaining healthy interpersonal relationships (Zeman, Cassano, Perry-Parrish & Stegall, 2006). Previous research has seen a major focus on emotion regulation strategies in young children and infants (Stifter & Moyer, 1991), and in adults (Gross & John, 2003) however, the preadolescent stage of development has not been adequately studied. Preadolescent children aged between eight and thirteen experience important milestones involving the acquisition of social, emotional and cognitive skills (Gross and Muñoz, 1995).

It has been proposed that alexithymia is, at least in part, a disorder of emotional regulation (Bagby et al., 1994). Taylor (2000) has suggested that alexithymia results in impaired cognitive-experiential processing of emotions limiting the identification, regulation and communication of emotional states. Consistent with this, it has been reported that disordered emotional regulation and alexithymia are associated in adolescent and adult populations (Venta, Sharp & Hart, 2012; Taylor, 2000; Swart et al., 2009). The majority of the previous literature posits that alexithymia has a global influence on emotion regulation, with alexithymic individuals utilising less reappraisal and more expressive suppression in

their emotion regulation strategies (Swart et al., 2009; Chen, Xu, Jing & Chan, 2011; Khosravani, Bastan, Avatefi & Mofidi, 2018). However, Laloyaux, Fantini, Lemaire, Luminet and Larøi (2015) reported that alexithymia was exclusively related to expressive suppression, as no significant correlation between alexithymia and cognitive reappraisal was found. However, the majority of the previous studies utilised the total TAS-20 score in their analyses. As such, the potential unique contributions of the TAS-20 subfactors on emotion regulation skills remains relatively understudied. Furthermore, if similar patterns of associations between alexithymia and maladaptive emotion regulation exist has yet to be investigated in a sample of preadolescent children.

1.8.1. *Childhood Depressive Symptoms' Relationship with Alexithymia and Emotion Dysregulation*

Before the late 1970's, childhood depression was rarely recognised and investigated in psychological research (Costello, Erkanli & Angold, 2006). However, over the past four decades research has focused on understanding the aetiology and epidemiology of clinical depressive illness and depressive symptoms in children. Studies have found a point prevalence of depressive illness between 0.3 % and 7.8% in preadolescent school-aged children (Steinhausen & Metzke, 2003), increasing to between 2.1% and 8.9% in 13 to 18 year olds (Angold et al., 2002; Fleming & Offord, 1990). In addition, a point-prevalence rate of subclinical depressive symptoms within preadolescent children has been estimated at 8.9%, with a yearly rate of 20.7% (Cooper & Goodyer, 1993). However, it appears much of this symptomology goes unrecognised, with one study finding none of the 375 children with clinical levels of depression were known to medical services (Cooper & Goodyer, 1993). Recent developments have identified potential short and long term correlates of childhood depression, both at clinical and subclinical levels of severity. For example, depressive symptoms have been associated with anxiety and internalizing problems during childhood

(Bufferd, Dougherty, Carlson, Rose & Klein, 2012; Kane & Garber, 2004; Hankin, 2015). Furthermore, early-life depressive symptoms have been found to be a significant predictor of substance abuse during adolescence (Diego, Field & Sanders, 2003) and obesity, suicidal behaviour and having a full major depressive episode in adulthood (Judd et al., 1997).

The relationships between depressive symptoms and alexithymia (Hintikka et al., 2001) and maladaptive emotion regulation strategies (Campbell-Sills, Barlow, Brown, & Hofmann 2006; see Compare, Zarbo, Shonin, Van Gordon & Marconi, 2014 for review) have been well established in both clinical (Bamonti et al., 2010) and non-clinical (Honkalampi, Saarinen, Hintikka, Virtanen & Viinamäki, 2000) adult populations. As previously discussed in this chapter, TAS-20 scores have been found to be significantly higher in clinically depressed adults (Bamonti et al., 2010) and correlate significantly with ratings of depressive symptoms in otherwise healthy samples (Hendryx, Haviland & Shaw, 1991). Furthermore, higher rates of expressive suppression and lower utilisation of cognitive reappraisal strategies in elevated depressive symptoms has been found in both child, adolescent (Betts et al., 2009) and adult (Joormann, 2010) samples.

However, much of the literature assessing the relationships between alexithymic traits, depressive symptoms and emotion regulation strategies has failed to investigate all three of these psychological factors simultaneously in preadolescent children. Previous studies have suggested children who scored highly in depressive symptoms showed higher use of expressive suppression and lower use of cognitive reappraisal strategies, similar to adult populations (Hughes, Gullone & Watson, 2011; Gullone & Taffe, 2011; Kudinova, James, Gibb, 2018). However, these authors did not investigate the effects of alexithymia in their samples. Additionally, there has been little investigation into the relationship between depressive symptoms and alexithymia in children. In one study, Allen and colleagues (2011) investigated the relationship between alexithymia and depressive symptoms, finding a small

but statistically significant correlation (r = .232) in a sample of older children (mean age = 12.70). However, the authors administered the adult TAS-20 to the children, did not administer a complementary peer-report measure of alexithymia to the children's parent(s), did not assess the potential unique contributions of the measure's subfactors and did not assess possible underlying maladaptive emotion regulation. In sum, the role of alexithymia on the known relationship between maladaptive emotion regulation and early-life depressive symptoms is not yet fully understood.

1.9. The Behavioural Correlates of Child Alexithymia: An Emotion Recognition Perspective

Understanding and recognising nonverbal cues from others is an integral life skill that develops during early childhood. The correct interpretation of nonverbal cues, notably emotional facial expressions, facilitates healthy interpersonal interactions and supports the development of emotional intelligence well into adulthood (Halberstadt, Denham & Dunsmore, 2001). As early as seven months old, infants can discriminate positive from negative affect (Oster, 1981), demonstrating a visual preference towards happy faces (Nelson & de Haan, 1996). As the brain continues to develop from early to late childhood, a more complex and nuanced understanding of others' emotions occurs (Chronaki, Hadwin, Garner, Maurage & Sonuga-Barke, 2015). It has been suggested emotion recognition skills greatly advance between the ages of six and ten years old (Herba, Landau, Russell, Ecker & Phillips, 2006). However, children may begin to exhibit symptoms of psychopathology during this period of development (Muris & Ollendick, 2005). Within adult studies, it has been well established that many psychiatric illnesses negatively influence emotion recognition abilities (Edwards, Jackson & Pattison, 2002; Domes, Schulze & Herpertz, 2009; Daros et al., 2013). However, it is of interest to identify when these deficits come into fruition during cognitive development. As such, modest efforts have been made in identifying the potential influence

underlying child psychopathology has on emotion recognition skills and its time-course.

1.9.1. *The Associations between Childhood Depressive/Anxiety Symptoms and Emotion Recognition Abilities*

As previously described in Section 1.3.1, it has been hypothesised individuals with marked depressive symptoms selectively attend to negatively valenced emotional stimuli (i.e., sadness) while attenuating away from positively valenced emotional stimuli (i.e., happiness). While the vast majority of the previous literature has been conducted in adolescents and adults (McClure, Pope, Hoberman, Pine & Leibenluft, 2003; Hallion & Ruscio, 2011), children have demonstrated similar negative cognitive biases in recent investigations. In an emotional dot-probe task conducted by Joorman and colleagues (2007), children at risk of depressive illness were found to selectively process negative facial expressions significantly quicker compared to healthy controls (Joormann, Talbot & Gotlib, 2007). Children with severe mood dysregulation have also been found to react more fearfully to emotionally neutral faces (Brotman et al., 2009). Furthermore, within previous neuroimaging studies, children with bipolar affective disorder (BPAD) have been found to exhibit hypoactivation of the amygdala when presented with images of happy expressions (Kalmar et al., 2009). Despite these promising findings in clinical populations, the extent to which they are replicated in nonclinical child populations has been little investigated, in contrast to adults (Laeger et al., 2012).

Furthermore, children with clinically significant anxiety have also been found to exhibit cognitive biases in their emotion recognition skills. Similar to adult populations, a hypervigilance towards threatening stimuli has been seen across numerous behaviour studies, including eye-tracking (Wieser et al., 2009), psychophysiological (Chalmers et al., 2014) and emotion recognition (McClure et al., 2007) methodologies. As such, the most consistent finding across the previous literature in younger populations is anxious children selectively

attend to fearful and angry faces significantly more than healthy controls (McClure et al., 2007; Waters, Henry, Mogg, Bradley & Pine, 2010; Salum et al., 2017). Furthermore, children with social phobia have been found to make more errors in the identification of happy faces (Simonian, Beidel, Turner, Berkes & Long, 2001). These findings have been supported by previous neuroimaging studies, in which children with generalized anxiety disorder (GAD) were found to have hyperarousal of the amygdala in response to briefly presented angry expressions (Monk et al., 2008). However, similar to previous investigations of children with mood disorders, it is also unclear to what extent subclinical anxiety symptoms influence emotion recognition, as seen in nonclinical adult samples (Laeger et al., 2012).

Depressive and anxiety symptoms are known to be comorbid in children both in clinical and typically developing populations (Brady & Kendall, 1992; Cole, Truglio & Peeke, 1997). While the majority of the previous literature has investigated the influence of depressive and anxiety symptoms on emotion recognition separately, recent efforts have been made to measure both psychological phenomena concurrently within the tested samples. For example, in a sample of older children (mean age = 12.62) with an anxiety disorder diagnosis, co-occurring depressive symptoms were found to significantly impact on happiness and anger recognition (Morningstar, Dirks, Rapport, Pine & Nelson, 2017). The children's anxiety symptoms however were found to have no significant influence on emotion recognition abilities. These findings are supported by a meta-analysis conducted by Demenescu and colleagues (2010), which found MDD is significantly more correlated with emotion recognition difficulties compared to anxiety disorders. However, it is important to note only adult clinical studies were included in the analysis. As such, it remains unclear to what extent subclinical depressive and anxiety symptoms influence emotion recognition in typically

developing children. Furthermore, other known negative influences on emotion recognition, particularly elevated alexithymic traits, have yet to be assessed in preadolescent samples.

1.10. Aims of this Body of Research in Child Populations

The next set of aims of this programme of research are threefold: (i) to generate a more thorough understanding of the reliability of measuring alexithymia in children and to assess the congruent validity of a self- and parent-reported measure of alexithymic traits (Chapter 5) (ii) to investigate the role of child alexithymia on the relationship between maladaptive emotion regulation and depressive symptoms (Chapter 6) and (iii) to assess potential emotion recognition deficits in child alexithymia using an emotional expression morphing paradigm (Chapter 7).

1.11. Thesis Overview and Summary

The first chapter of this thesis aims to give the reader a background understanding of the alexithymia construct, make them aware of the limited body of literature investigating the psychometric and behavioural correlates of alexithymic traits in healthy adult and child populations and highlight the possible adverse psychological and health consequences of alexithymia.

The thesis first assesses alexithymic traits in adults (Chapters 2, 3 and 4). A large body of evidence has found associations between alexithymia, experiences of childhood adversity and depressive/anxiety symptoms during adulthood. However, the vast majority of the previous literature has exclusively investigated these associations in clinical populations.

Chapter 2 aims to assess the potential role of alexithymia on the known relationship between childhood trauma and later-life depressive/anxiety symptoms in a sample of 373 adults recruited from the general public. A series of mediation analyses will be employed to

ascertain which if any of the three alexithymia constructs, DIF, DDF and/or EOT emerge as significant mediator(s) in this relationship.

Chapter 3 will aim to assess the potential relationship between alexithymic traits and emotional processing deficits using an emotional expression morph task in a sample of 96 adults. Considering an extensive body of literature has been produced regarding the influence of depressive/anxiety symptoms on the processing of emotional expressions, it was of interest to ascertain if alexithymia showed similar patterns of associations. Regression analyses will be employed to identify which of the key assessment variable(s) emerge as significant predictors of task performance.

Chapter 4 will aim to assess the distinctiveness of alexithymia from depressive/anxiety symptoms using a series of exploratory factor analyses. Furthermore, it was of interest to ascertain which of the three alexithymia constructs, DIF, DDF or EOT may constitute as 'core' alexithymia in adults.

The last section of this thesis assesses alexithymia in preadolescent children aged between 8 and 13 (Chapters 5, 6 and 7). The previous literature investigating child alexithymia has been limited by a paucity of child-appropriate assessment tools.

Considering this, Chapter 5 assesses the psychometric properties of a newly published parent-report measure of alexithymic traits and is compared to a previously established self-rated child measure (n = 250 children, n = 250 parents). Furthermore, the potential differences in the two measures' associations with known correlates of alexithymia (e.g., depressive symptoms and empathic behaviour) will be investigated.

Based on Chapter 2's encouraging findings in adults, Chapter 6 assesses the role of childhood alexithymia on the established relationship between emotion dysregulation and depressive symptoms using a series of mediation analyses.

Chapter 7 attempts to replicate the findings of Chapter 3 by administering an emotional expression morph task to 50 healthy children in order to identify the potential influence early-life alexithymic traits has on emotional processing.

Lastly, Chapter 8 reviews the findings from the empirical studies, describes the potential clinical utility of the findings and suggests future directions in alexithymia research in both child and adult samples.

In sum, this body of research describes a series of novel investigations that aim to gain a more in-depth understanding of the psychometric and behavioural correlates of alexithymia. By utilising a number of different methodologies and assessing alexithymia in both children and adults, a greater insight into the antecedents and sequelae of alexithymic traits in individuals from the general populace may be obtained.

Chapter 2

Empirical Study 1:

CHILDHOOD TRAUMA, DEPRESSIVE SYMPTOMS AND ANXIETY: THE MEDIATING ROLE OF ALEXITHYMIA

2.1. Introduction

A history of childhood trauma is perhaps one of the most extensively documented antecedents of later-life psychopathology. A significant effort has been made in past research to identify the effects that childhood adversity have on mental well-being, from early childhood (Anda et al., 2006) to late adulthood (Cohen et al., 2006). While there is a large body of literature documenting the relationship between childhood adversity and psychiatric illnesses, such as depression and anxiety, much of this research has been conducted in clinical samples. Furthermore, the potential mediating role of alexithymia in this relationship has not yet been investigated in a sample from the general population.

Alexithymia has been found to be a significant mediator in the relationship between previous trauma and adult psychopathology, particularly disordered eating (Mazzeo, Mitchell & Williams, 2008; Mazzeo & Espelage, 2002; Hund & Espelage, 2005) and nonsuicidal self-injury (Paivio & McCulloch, 2004; Peh et al., 2017). Furthermore, a mediating effect of alexithymia on the relationships between childhood trauma and sexual risk taking (Hahn, Simons & Simons, 2016), impulsive behaviours (Gaher, Arens & Shishido, 2015) and somatic complaints (Ogrodniczuk et al., 2014) has been identified. However, only a minority of these studies have measured co-occurring depressive and anxiety symptoms (e.g., Hund &

Espelage, 2005; Mazzeo et al., 2008; Peh et al., 2017). Furthermore, symptom scores were predominantly only used as covariates in the authors' analyses.

To the authors' knowledge, only one study has directly investigated the relationships between alexithymia, childhood adversity, anxiety and depressive symptoms concurrently. In a recent study conducted by Brown and colleagues (2016), path analysis revealed a significant role of alexithymia in the relationship between childhood trauma and internalizing problems such as depression, anxiety and loneliness. While the results are of interest, the researchers used the total TAS-20 score and did not investigate the potential effects of the measure's subscales. This may have implications on the authors' conclusions, as the subfactors have been found to vary in their associations with global psychopathology (Grabe et al., 2004). Therefore, the current study will address this limitation by investigating the potential unique contributions of the TAS-20's subfactors on the relationship between childhood adversity and later-life depressive and anxiety symptoms.

2.1.1. *Interoception*

The significant relationships between alexithymia, childhood trauma, depressive symptoms and anxiety may, in part, be explained by deficits in interoception. Interoception refers to the awareness of one's internal bodily states. Early theoretical frameworks focused predominantly on the awareness of visceral bodily states such as heart rate, temperature and hunger (Murphy et al., 2017), however recent speculations suggest interoceptive awareness contains both physical and psychological domains. For instance, interoception has been found to influence higher-order cognition, such as emotional understanding (Seth, 2013), regulation (Füstös, Gramann, Herbert & Pollatos, 2013) and possibly even self-generated thoughts or actions (Fletcher & Frith, 2009). Disturbances of interoceptive awareness have been associated with several negative psychological outcomes, such as an increased risk of

substance misuse (Paulus & Stewart, 2014), anxiety and depressive symptoms (Paulus & Stein, 2010). As such, poor interoception has been proposed as one explanation for the general factor of psychopathology, or 'p', factor that may account for symptom commonalities across numerous psychiatric illnesses (Caspi et al., 2014). Additionally, it has been suggested interoception abnormalities may be the result of previous childhood trauma (Kong & Bernstein, 2009).

In a recent review, Murphy and colleagues (2017) noted a significant overlap of alexithymia and interoception, suggesting alexithymic tendencies may be measured as a proxy for atypical interoceptive awareness. Elevated total TAS-20 scores have been found to be associated with poorer performance on interoceptive tasks, such as heartbeat detection paradigms (Herbert, Herbert & Pollstos, 2011) and lower scores on interoceptive awareness self-reports (Longarzo et al., 2015). The authors speculated that this relationship may be predominately driven by the TAS-20 domain DIF, as both DIF and poor interoception involve abnormal emotional awareness (Murphy et al., 2017). While a mediating role of global alexithymic traits has been found between childhood trauma and later-life psychopathology, the specific effect of DIF has not previously been explored.

2.1.2. *The Current Study*

While it has been well documented that childhood trauma may predispose individuals to develop later-life psychopathological symptoms, most of the previous investigations have been conducted in clinical samples. It is known that alexithymic traits, experiences of childhood adversity and depressive/anxiety symptoms fall on wide spectrums of severity, even within the general population (Honkalampi et al., 2000). Despite the promising results yielded by previous clinical studies, the subjects tested represent the extreme end of these continua and therefore limit the applicability of the results to the wider population. As such, it

remains unclear how these three psychological phenomena interact within individuals from the general populace. The aim of the current chapter was to therefore assess if alexithymia is a significant mediator in the relationship between childhood trauma and later-life depressive/anxiety symptoms in a sample from the general public. Furthermore, it is hypothesised the TAS-20 subfactor DIF will emerge as the main mediator in this relationship (see Figure 2.1).

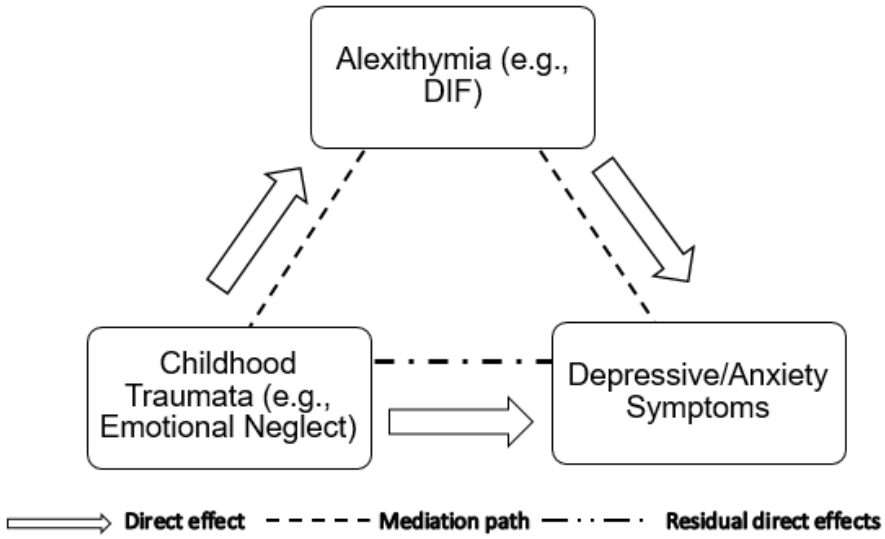

Figure 2.1. Hypothetical mediation model, with childhood trauma as the independent variable, depressive/anxiety symptoms as the dependant variable and alexithymia as the mediator.

2.2. Methods

2.2.1. *Participants*

Three hundred and seventy three adults participated in the current study. Participants were recruited via links to the questionnaire posted on social networking sites, study email invitations and through an undergraduate subject pool. Undergraduate subjects were compensated with course credits for participating. The sample consisted of 56 males, 295 females and 6 gender non-specific individuals, with a mean age of 32.43 (SD = 12.88).

Participant age ranged from 18 to 72 years old. Highest educational attainment ranged from no qualifications (0.8%), school qualifications (16.5%), undergraduate degree (42.4%), postgraduate degree (34.9%) to doctoral degree (1.3%).

2.2.2. *Measures*

2.2.2.1. Toronto Alexithymia Scale (TAS-20).

Developed by Bagby and colleagues (Bagby et al., 1994), the TAS-20 is a widely administered self-assessed measure of alexithymic trait severity. Consisting of three subscales, DIF (e.g., "I don't know what's going on inside me"), DDF (e.g., "It is difficult for me to reveal my innermost feelings, even to my close friends") and EOT (e.g., "Being in touch with emotions is essential"), items are rated from 1 = "Never" to 5 = "Always" with a score range of 20 to 100. Completion of the TAS-20 took approximately eight minutes. The total measure is considered to be psychometrically sound, with good internal consistency ($\alpha >$ .800; Parker et al., 2003), and concurrent validity (Bagby et al., 1994). Higher scores were indicative of more pronounced alexithymia.

2.2.2.2. Hospital Anxiety and Depression Scale (HADS).

The HADS (Zigmond & Snaith, 1983) is a widely administered 14-item screening measure of depression and anxiety. The measure is considered to have high sensitivity (.800) and specificity (.880) to detect clinical levels of symptom severity (Olssøn, Mykletun & Dahl, 2005; Bjelland, Dahl, Haug & Neckelmann, 2002). Furthermore, the HADS has been found to have good internal consistency ($\alpha >$ .800; Mykletun, Stordal & Dahl, 2001). Participants rated items from the two subscales 'HADS-D' (e.g., "I feel as if I'm slowed down") and 'HADS-A' (e.g., "I get sudden feelings of panic") on a 4-point scale, with scores ranging from 0 – 21 for each subscale. Completion of the HADS took approximately eight minutes. Higher scores were indicative of more severe depressive/anxiety symptoms.

2.2.2.3. Childhood Trauma Questionnaire (CTQ).

The CTQ (Bernstein & Fink, 1998) is a 28 item retrospective measure that assesses adverse childhood experiences. Participants rated the occurrences from 1 = "Never" to 5 = "Always" on five types of trauma; emotional abuse, emotional neglect, physical abuse, physical neglect and sexual abuse. Each subscale, consisting of five items, is scored from 5 to 25 with higher scores indicating a greater prevalence of traumatic experiences. Completion of the CTQ took approximately eleven minutes. The measure has been found to have good internal consistency ($\alpha > .900$, Bernstein & Fink, 1998) and convergent validity with other measures of psychopathology (Bernstein, Ahluvalia, Pogge & Handelsman, 1997). Furthermore, the additional three items measuring minimization/denial (e.g., "My family were the best in the world") were within the acceptable range (<1; Bernstein & Fink, 1998). An overview of the CTQ subfactor cut-off scores can be seen in Appendix 1 Section A1.1.

2.2.3. *Procedure*

An anonymous online questionnaire consisting of all the measures was developed using the survey builder software Qualtrics (see Appendix 1 Section A1.2). Three methods were used in order to recruit participants over two waves of questionnaire dissemination. Firstly, the link to the questionnaire was posted on social media networks. Secondly, a study invitation email was sent to faculty members of the Edinburgh University Psychology department. Lastly, the questionnaire was advertised on an undergraduate subject pool, in which students participate in order to receive course credit. Prior to completing the questionnaire the participants were presented with an electronic information sheet. Subjects were informed that their responses would be anonymous and that they may exit the questionnaire at any time without consequence. Participants then provided informed consent and completed the questionnaire. Each measure took approximately ten minutes to complete,

resulting in a total participation time of thirty minutes. At the end of the survey, participants were asked to provide their age, gender and their highest educational attainment. Data was analysed using SPSS version 22 (IBM Corporation, Armonk, NY, USA). The study was approved by the University of Edinburgh Research Ethics Committee (29-1718/4).

2.2.4. *Statistical Analyses*

After assessing missing data and removing multivariate outliers from the dataset, descriptive data were then calculated for all the key variables. A correlation matrix was computed in order to investigate the relationships between the total and subscale scores of the HADS, CTQ and TAS-20. TAS-20 scores were parsed into the three proposed subfactors, DIF, DDF and EOT. HADS scores were parsed into HADS-D (depressive symptom subscale) and HADS-A (anxiety symptom subscale). Finally, CTQ scores were parsed into the individual trauma scores; emotional abuse (EA), emotional neglect (EN), physical abuse (PA), physical neglect (PN) and sexual abuse (SA).

To investigate the mediating effects of alexithymia on the relationship between childhood trauma, depressive symptoms and anxiety, a multiple mediation analysis was used, as developed by Preacher and Hayes (2008). Mediation was assessed by directly testing the significance of the indirect effect of the independent variable (childhood trauma; CTQ) on the dependant variable (Depressive symptoms/anxiety; HADS) through the mediators (alexithymia; the TAS-20 subfactors DIF and DDF). Mediation analyses were conducted with the SPSS macro PROCESS (Hayes, 2012), with model 4 (mediators in parallel) and 6 (mediators in series) selected as they facilitate the use of multiple mediators. For mediation completeness, the order of the in-series variables was reversed in secondary analyses. As suggested by Preacher and Hayes (2008), 95% confidence intervals of the standard error were bootstrapped with 5000 samples in order to assess if the mediation effect(s) were significant.

This method was used instead of a post-hoc Sobel test, as there is a growing consensus that this is sensitive to deviations from its assumptions (Preacher & Hayes, 2008). Mediation was considered statistically significant when the bias corrected and accelerated 95% confidence intervals of the indirect effect did not include zero.

2.3. Results

2.3.1. *Data Preparation*

A total of 445 participants consented to taking part in the questionnaire over the two waves of dissemination. On inspection of the raw data, 53 participants failed to complete one to all of the measures administered. Twenty-four participants did not complete the TAS-20, 6 did not complete the HADS and 23 did not complete the CTQ. Once the participants who left whole measures blank were removed, the degree of missing data was assessed. An *a priori* missing data rule was applied to remove participants; those with four or more missing data points from any of the individual measures were removed from the dataset. Furthermore, due to the sensitive nature of the CTQ, an additional 'Do Not Want to Answer' response was included if participants did not feel comfortable answering particular item(s). These responses were considered missing data. Using this rule, a further 17 participants were removed. The 19 subjects who did not leave demographic information were not removed from the dataset as this was not considered integral to the current study. Averages of the items with missing data were calculated and inserted to generate full scores. The normality of the key variable total score distributions then was assessed. A departure from normality was defined as a skewness value >2 and a kurtosis value >7, as proposed by West, Finch and Curran (1995). Using this method, none of the key variables were found to have skewness or kurtosis values above West and colleagues' (1995) established cut-offs. Lastly, in order to identify multivariate outliers, data was screened using Mahalanobis' distance with a criterion

of p <.001. Two participants were found to be over the critical chi-square value of 16.27, and were therefore removed from the dataset. This gave a final sample size of 373 participants.

2.3.2. *Descriptive Data*

The score means, standard deviations, ranges and the degree of alexithymic trait, depressive symptom, anxiety and childhood trauma severity in the sample are shown in Table 2.1. Within large samples, a score of 61 and above on the TAS-20 has been established to identify alexithymic individuals (Bagby et al., 1994). Using this cut-off, 46 participants (12.3%) were found to have elevated alexithymic traits, slightly higher than what would be expected in the general population (~10%; Mattila et al., 2006). The HADS subscale HADS-D revealed 26 (7%) participants had moderate to severe depressive symptoms using the cut-off-score of 11 and above (Zigmond & Snaith, 1983), consistent with previous studies conducted in healthy adults (Hinz & Brähler, 2011). Furthermore, the HADS-A subscale identified 141 (37.80%) of the sample experiencing moderate to severe anxiety, comparable to previous investigations (Hinz et al., 2014). Lastly, CTQ traumata subscale score ranges were within those typical of nonclinical adults (Klinitzke, Romppel, Häuser, Brähler, & Glaesmer, 2012).

2.3.2.1. Gender effects

As the study's sample was biased towards female participants, independent sample t-tests bootstrapped with 5000 iterations were performed in order to identify any gender effects on the key variables. The t-tests revealed no significant gender effects on TAS-20 ($t(348) = .432$, $p = .666$), depressive symptom ($t(348) = -.747$, $p = .455$) and total CTQ scores ($t(348) = -.327$, $p = .744$). On inspection of the trauma subtypes, no significant gender effects were found on emotional abuse ($t(348) = -1.83$, $p = .069$), emotional neglect ($t(348) = 1.07$, $p = .286$), physical abuse ($t(348) = .807$, $p = .420$), physical neglect ($t348) = .631$, $p = .529$) or

Table 2.1.

Key variable score demographics and distributions of alexithymia, depressive/anxiety symptoms and childhood trauma

Score Demographics					Distributions of alexithymia, depressive/anxiety symptoms and childhood trauma in sample (n = 373)			
Measure	Subscale	Mean	SD	Range	Subthreshold (%)	Low (%)	Moderate (%)	Severe (%)
TAS-20		46.89	10.87	22 –79	253 (67.8)	n.a	74 (19.9)	46 (12.3)
	DIF	16.69	5.66	7 – 32				
	DDF	12.39	4.19	5 – 25				
	EOT	17.82	3.97	7 – 32				
HADS		13.75	7.02	0 – 36				
	HADS-A	9.24	4.29	0 – 21	142 (38.1)	90 (24.1)	96 (25.7)	45 (12.1)
	HADS-D	4.51	3.59	0 – 19	298 (79.9)	49 (13.1)	22 (5.9)	4 (1.1)
CTQ		36.87	11.42	25 –79				
	EA	9.35	4.62	5 – 24	207 (55.5)	92 (24.6)	28 (7.5)	46 (12.4)
	EN	9.71	4.50	5 – 25	215 (57.6)	93 (24.8)	42 (11.2)	23 (6.4)
	PA	5.92	2.79	5 – 17	324 (86.8)	34 (9.1)	9 (2.5)	6 (1.6)
	PN	6.28	2.09	5 – 17	309 (82.4)	32 (8.5)	23 (6.1)	9 (3.0)
	SA	5.70	2.18	5 – 22	313 (83.9)	27 (7.2)	21 (5.6)	12 (3.3)

Note. TAS-20: Toronto Alexithymia Scale, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, HADS: Hospital Depression and Anxiety Scale, HADS-D: Depression subscale, HADS-A: Anxiety subscale, CTQ: Childhood Trauma Questionnaire, EA: Emotional Abuse, EN: Emotional Neglect, PA: Physical Abuse, PN: Physical Neglect, SA: Sexual Abuse, n.a: not applicable.

sexual abuse (t(348) = -1.384, p = .167) scores. However, a significant effect was found in anxiety scores, with female participants more anxious than males (t(348) = -2.59, p = .010).

2.3.2.2. Highest educational attainment group differences

One-way ANOVAs revealed no statistically significant differences between educational attainment groups and anxiety (F(4,350) = 1.14, p = .336) and depressive symptom (F(4,350) = 1.58, p = .179) scores. Educational attainment was significantly negatively associated with increased alexithymia (F(4,350) = 4.16, p = .003) and childhood trauma score (F(4,350) = 3.11, p = .016).

2.3.3. *The Relationships between the Key Variables*

A Pearson correlation matrix was computed in order to assess the relationships between the total and subscale scores of the TAS-20, HADS and CTQ (see Table 2.2). At the total score, depression/anxiety symptoms were found to correlate significantly with both alexithymia (r = .524, p < .001) and childhood trauma (r = .338, p < .001). Alexithymia and childhood trauma was also found to share a significant correlation (r = .251, p < .001). The TAS-20 subscale DIF was found to share significant correlations with participant age, depressive symptoms, anxiety and all but one CTQ subscale (sexual abuse; r =.086, p = .098). Similarly, DDF correlated with participant age, depressive symptoms, anxiety and all but two CTQ subscales (physical abuse; r = .038, p = .468, sexual abuse; r = .004, p = .943). EOT did not share significant relationships with any of the other variables other than depressive symptoms (r = .155, p = .003).

Table 2.2.

Correlation matrix of the key variables' total and subfactor scores and participant age.

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.*TAS-20*	/	.851***	.856***	.625***	.524***	.497***	.442***	.251***	.208**	.291***	.091	.175***	.034	-.113*
2.DIF		/	.645**	.225***	.628***	.543***	.574***	.339***	.325***	.329***	.149**	.217***	.086	-.134*
3.DDF			/	.371***	.421***	.411***	.345***	.213***	.161**	.277***	.038	.179***	.004	-.141**
4. EOT				/	.097	.155**	.029	-.022	-.063	.036	-.003	-.019	-.034	.036
5.*HADS*					/	.869***	.91***	.338***	.326***	.346***	.154**	.211***	.043	-.124*
6. HADS-D						/	.587***	.351***	.314***	.391***	.125*	.256***	.020	-.038
7. HADS-A							/	.260***	.271***	.239***	.147**	.132*	.053	-.172**
8.*CTQ*								/	.878***	.873***	.599***	.741***	.394***	.041
9.EA									/	.664***	.518***	.521***	.203***	.003
10.EN										/	.386***	.677***	.150**	.036
11.PA											/	.293***	.179***	-.001
12.PN												/	.191***	-.025
13.SA													/	.159**
14.Age														/

Note. TAS-20: Toronto Alexithymia Scale, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, HADS: Hospital Depression and Anxiety Scale, HADS-D: Depression subscale, HADS-A: Anxiety subscale, CTQ: Childhood Trauma Questionnaire, EA: Emotional Abuse, EN: Emotional Neglect, PA: Physical Abuse, PN: Physical Neglect, SA: Sexual Abuse.
*p < .05, **p < .01, ***p <.001

2.3.4. *Alexithymia's Mediation Effect on the Relationship between Childhood Trauma and Depressive Symptoms*

As the TAS-20 subscales DIF and DDF had significant correlations with both depressive symptoms and most of the CTQ trauma scores, DIF and DDF scores were selected as mediators in the model. The two mediators were added to the mediation sequentially, using the PROCESS model 6. The CTQ subscale sexual abuse was not entered into the analysis as it did not show significant relationships with the independent or mediator variables. Participant age, gender and highest educational attainment were controlled for in the mediation analyses. Results are shown in Table 2.3. On inspection of the 95% bias-corrected confidence intervals, DIF was found to significantly partially mediate the relationship between depressive symptoms and total CTQ [95% CI: .096, .544], emotional abuse [95% CI: .034, .221], emotional neglect [95% CI: .026, .204] and physical neglect [95% CI: .206, .543]. The relationship between depressive symptoms and physical abuse became nonsignificant when participant educational attainment, gender and age were corrected for [95% CI: -.004, .377]. DDF was found to have no significant mediating effect on the relationship between childhood trauma and depressive symptoms.

In order to establish DIF's exclusive mediating role, further secondary mediation models were run with DIF, DDF and EOT mediating in parallel using PROCESS model 4. Similar results were found when compared to the sequential mediation models. DIF was found to significantly partially mediate the relationship between depressive symptoms and total CTQ [95% CI: 100, .591], emotional abuse [95% CI: .083, .2816], emotional neglect [95% CI: .061, .146] and physical neglect [95% CI: .044, .235]. This means that indirect effects for depressive symptoms and total CTQ [95% CI: .027, .083], emotional abuse [95% CI: .052, .197] emotional neglect [95% CI: .110, .252] and physical neglect [95% CI: .075,

.372] remained significant. DDF and EOT did not emerge as significant mediators in the analyses.

Table 2.3.

Dual-mediation analysis with HADS-D score as the dependant variable, correcting for participant age, gender and educational attainment.

IV	M	B	SE	BootLLCI	BootULCI	Model R^2
CTQ	DIF	.343	.127	**.096**	**.596**	
	DDF	-.008	.021	-.057	.032	
	DIF + DDF	.027	.061	-.144	.099	
Total effect (c)		.308	.113	**.096**	**.544**	.168***
Direct effect (c')		.744	.181	**.387**	**1.10**	
EA	DIF	..185	.050	**.087**	**.285**	
	DDF	-.013	.011	-.039	.005	
	DIF + DDF	-.042	.027	-.096	.013	
Total effect (c)		.130	.047	**.034**	**.221**	
Direct effect (c')		.258	.075	**.111**	**.406**	.149***
EN	DIF	.064	.047	**.030**	**.155**	
	DDF	.011	.010	-.004	.036	
	DIF + DDF	.038	.025	-.010	.089	
Total effect (c)		.114	.049	**.026**	**.204**	.189***
Direct effect (c')		.366	.072	**.225**	**.508**	
PA	DIF	.111	.045	**.024**	**.201**	
	DDF	-.008	.010	-.031	.008	
	DIF + DDF	.019	.012	-.001	.046	
Total effect (c)		.187	.097	-.004	.377	.287***
Direct effect (c')		.066	.083	-.098	.230	
PN	DIF	.126	.051	**.043**	**.243**	
	DDF	.008	.010	-.008	.031	
	DIF + DDF	.019	.014	-.004	.052	
Total effect (c)		.375	.086	**.206**	**.543**	.086***
Direct effect (c')		.223	.075	**.075**	**.370**	

Note. IV: independent variable, M: mediators, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, CTQ: Childhood Trauma Questionnaire, EA: Emotional Abuse, EN: Emotional Neglect, PA: Physical Abuse, PN: Physical Neglect. ***p < .001. Significant mediation is indicated with bold font confidence intervals.

2.3.5. *Alexithymia's Mediation Effect on the Relationship between Childhood Trauma and Anxiety*

As DIF and DDF scores also shared significant relationships with anxiety, separate multiple mediation analyses were run using HADS-A scores as the independent variable. The CTQ subscale sexual abuse was not included in the analyses as there was no significant relationship between the CTQ subscale and both TAS-20 and HADS-A scores. Participant demographics were further controlled for in the analyses. Results from the multiple mediation analyses are shown in Table 2.4. DIF was found to fully mediate the relationship between anxiety and total CTQ score [95% CI: .191, .575] and emotional neglect [95% CI: .076, .231]. A significant partial mediation effect of DIF was found between anxiety and emotional abuse [95% CI: .095, .208] and physical abuse [95% CI: .046, .485]. The relationship between anxiety and physical neglect became nonsignificant when participant age, gender and educational attainment were controlled for [95% CI: -.011, .387]. DDF however was found not to have a significant mediating effect across the independent variables.

In order to establish DIF's exclusive mediating role, further secondary mediation models were run with DIF, DDF and EOT mediating in parallel using PROCESS model 4. Similar results were found when compared to the sequential mediation models. DIF was found to fully mediate the relationship between anxiety and total CTQ [95% CI: .038, .086], physical abuse [95% CI: .041, .281] and emotional neglect [95% CI: .101, .227]. Furthermore, DIF partially mediated the relationship between anxiety and emotional abuse [95% CI: .096, .208] as the indirect effect remained significant [95% CI: .002, .164]. DDF and EOT did not emerge as significant mediators in the analyses.

Table 2.4.

Dual-mediation analyses with HADS-A score as the dependant variable while correcting for participant age, gender and highest educational attainment.

IV	M	B	SE	BootLLCI	BootULCI	Model R^2
CTQ	DIF	.369	.115	**.139**	**.602**	
	DDF	-.001	.009	-.019	.020	
	DIF + DDF	.001	.006	-.011	.122	
Total effect (c)		.371	.097	**.191**	**.575**	.137***
Direct effect (c')		.315	.161	-.003	.632	
EA	DIF	.169	.047	**.081**	**.266**	
	DDF	.002	.005	-.006	.016	
	DIF + DDF	-.028	.027	-.080	.026	
Total effect (c)		.144	.040	**.069**	**.226**	.131***
Direct effect (c')		.149	.066	**.019**	**.278**	
EN	DIF	.152	.039	**.021**	**.196**	
	DDF	-.004	.007	-.022	.009	
	DIF + DDF	.048	.025	.001	.098	
Total effect (c)		.152	.039	**.076**	**.231**	.138***
Direct effect (c')		.103	.065	-.025	.231	
PA	DIF	.158	.060	**.044**	**.281**	
	DDF	.001	.007	-.010	.022	
	DIF + DDF	-.005	.011	-.030	.015	
Total effect (c)		.266	.112	**.046**	**.485**	.038*
Direct effect (c')		.111	.096	**.077**	**.299**	
PN	DIF	.045	.074	**.064**	**.346**	
	DDF	-.003	.007	-.021	.010	
	DIF + DDF	-.007	.013	-.037	.016	
Total effect (c)		.188	.101	-.011	.387	.061**
Direct effect (c')		.010	.087	-.162	.182	

Note. IV: independent variable, M: mediators, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, CTQ: Childhood Trauma Questionnaire, EA: Emotional Abuse, EN: Emotional Neglect, PA: Physical Abuse, PN: Physical Neglect. *p < .05, **p <.01, ***p < .001. Significant mediation is indicated with bold font confidence intervals.

2.4. Discussion

The current study identified an exclusive mediating role of the TAS-20 subscale DIF on the relationship between childhood trauma and the severity of depressive and anxiety symptoms. A consistent limitation of previous investigations into the mediating role of alexithymia on the relationship between childhood trauma and adult psychopathology has been the use of total TAS-20 scores. While results from these studies have been promising, it remained unclear which of the TAS-20 subscale(s) were producing the mediating effect. Results from this empirical chapter highlight the need for researchers to parse the TAS-20 into its subscales when assessing alexithymia's mediating effects.

Similar to previous investigations, global alexithymia, depressive symptoms and anxiety were found to significantly correlate with all but one of the childhood traumata measured. The CTQ subscale sexual abuse has routinely failed to correlate significantly with psychopathological symptoms, such as depressive and anxiety symptoms (Huh, Kim, Lee & Chae, 2017) and alexithymic traits (Paivio & McCulloch, 2004). It is possible the sexual acts themselves do not elicit an adverse effect on the individual; rather, the psychological consequences of the abuse may be more damaging. Supporting this notion, sexual abuse was found to correlate highly with the CTQ subscales emotion abuse and neglect in the current study. On parsing the TAS-20 into its proposed subscales, DIF and DDF showed similar correlations with global alexithymia scores. EOT however failed to correlate with all other measures, except weakly with depressive symptoms. A similar pattern of results has been found in previous studies investigating the relationship between alexithymia and adult psychopathology (Saarijärvi et al., 2006).

Multiple mediation analyses revealed a significant mediation role of DIF in the relationship between childhood trauma, depressive symptoms and anxiety. However, the

strength of DIF's mediation role was not consistent. The TAS-20 subscale fully mediated the relationship between total childhood trauma and anxiety, whereas it partially mediated the relationship between childhood trauma and depressive symptoms. In a previous study investigating the mediating role of maladaptive emotion regulation on the relationships between childhood adversity, depression and anxiety, a similar pattern of results were found (Huh et al., 2017). The authors speculated that deficits in executive function, associated with depression but not anxiety, may elicit difficulties in using adaptive coping strategies in response to negative emotions (Huh et al., 2017).

On inspection of the CTQ subscales, the relationships between emotional abuse and depressive/anxiety symptoms remained significant after partial mediation by DIF. Previous studies have speculated depression and certain subtypes of anxiety disorders are particularly associated with a history of psychological abuse (Gibb et al., 2007). Emotional neglect's relationship with depressive symptoms was also partially mediated by DIF, but fully mediated in its relationship with anxiety. Additionally, the relationship between physical neglect and depressive symptoms was partially mediated by DIF scores, while physical neglect and anxiety's relationship became non-significant once participant demographics were corrected for. These findings support previous speculations that a history of emotional neglect is more associated with later depression than anxiety (Hovens et al., 2015). In contrast, DIF partially mediated the relationship between physical abuse and anxiety, whereas the traumata's relationship with depressive symptoms became non-significant when participant demographics were corrected for in the mediation model. This finding is consistent with previous investigations which reported that anxiety, but not depression, is associated with having experienced abusive behaviour from caregiver(s) during childhood (Cougle et al., 2010).

Despite showing significant correlations with childhood trauma, depressive symptoms and anxiety, DDF did not emerge as a significant mediator in the mediation models. This remained the case irrespective of the sequence of the in-series and in-parallel models in the mediation analyses. It may be that communicating one's feelings (DDF) first requires their identification (DIF). In addition, secondary mediation analyses revealed no mediation effect of EOT with all the TAS-20 subscales mediating in-series. Therefore, supporting the speculations made by Murphy and colleagues (2017), it appears DIF may constitute the 'core' of alexithymia, at least as far as its effects on psychopathology are concerned.

The exclusive mediating role of DIF on the relationship between childhood trauma, depressive symptoms and anxiety may be explained by underlying interoceptive awareness deficits. It has been suggested the brain areas responsible for interoception are the anterior insula and the anterior cingulate cortex (Craig, 2009). During puberty, the brain undergoes significant functional and structural changes (Yurgelun-Todd, 2007), notably in the brain areas responsible for higher cognitive function such as social and emotional understanding (Spear, 2000). Exposure to maltreatment during this critical period may adversely impact on brain development (De Bellis & Zisk, 2014). Neuroimaging studies have identified a relationship between previous childhood adversity and deficits in anterior insula activation (McCrory et al., 2011; Hein & Monk, 2017), which may result in poor interoceptive awareness, a known risk factor for adult psychopathology. As such, altered insula activation has been found to be associated with depression and anxiety in later life (Stein, Simmons, Feinstein & Paulus, 2007) as well as heightened scores on DIF (Zhang et al., 2011). Poor interoceptive awareness has been suggested to be closely associated with alexithymia, particularly difficulties in identifying one's emotions, as measured by DIF (Murphy et al., 2017). Considering the current study's findings, it therefore seems possible alterations to the insula caused by maltreatment during critical periods of brain development may induce

difficulties in interoceptive awareness and emotion identification, in turn making individuals more susceptible to depressive and anxiety symptoms in later life.

2.4.1. *Strengths*

The current study has a number of strengths. First, to the author's knowledge this is the first to identify a mediating role of DIF on the relationship between previous childhood trauma and severity of depressive and anxiety symptoms. Second, the current study obtained a relatively large sample size of 373 participants, despite the highly sensitive nature of the study. Following this, the third strength was the anonymity of the online questionnaire. With regards to highly sensitive information, notably an individual's history of childhood adversity, anonymity facilitated participants to be as truthful in their responses as possible. Only twelve of the 373 participants selected a 'Do Not Want to Answer' response option while completing the CTQ, notably on the items regarding sexual abuse, suggesting the majority of the participants were willing to disclose their full history of childhood trauma during study participation. Lastly, the distributions of alexithymic traits, depressive symptoms, anxiety and childhood trauma in the current study's sample were typical of the general population.

2.4.2. *Limitations*

The current study does have some limitations. Primarily, the sample was largely comprised of female participants. Previous studies investigating alexithymia in the general public have often been sensitive to gender biases, particularly when administering online questionnaires (Murphy, Wulff, Catmur & Bird, 2018; Rehman, Gumley & Biello, 2018). Despite this, of all the variables assessed, a significant effect of gender was only identified on anxiety scores, known to be significantly more prevalent in females (Eisenberg, Gollust, Golberstein & Hefner, 2007). Furthermore, participant gender was corrected for in the

study's mediation models. It was found in post-hoc analysis that the removal of participant gender as a covariate did not alter alexithymia's mediation effects. Therefore it appears gender does not significantly influence the relationships between alexithymia, global childhood adversity and depressive/anxiety symptoms. However, in order to further consolidate this finding, this study requires replication in a sample with a more even gender distribution. Secondly, childhood adversity was assessed using a retrospective self-report. While recall biases may have been introduced, the CTQ has been regarded as a reliable measure of previous childhood trauma (Hardt, Vellaisamy & Schoon, 2010). As the study employed a cross-sectional design, the causal directions discussed are speculative. Future longitudinal designs are required to establish this. Thirdly, it would have been beneficial for the current study to administer a direct measure of interoceptive awareness, however a psychometrically sound and valid self-report instrument of interoception has yet to be developed (Murphy et al., 2017). Lastly, the study utilised a general rather than a clinical population, so the results cannot be extrapolated into clinical practice.

2.4.3. *Conclusion*

The current study adds to the growing literature on the mediation role of alexithymia between childhood adversity and adult psychopathology. The relationship between childhood trauma and the severity of adult depressive and anxiety symptoms was in part explained by underlying alexithymic traits, notably DIF. As such, results from the current study suggest individuals with a history of childhood adversity, particularly psychological trauma, may benefit from therapeutic strategies addressing underlying emotional understanding deficits. By doing so, their co-occurring depressive and anxiety symptoms may be ameliorated. Future studies are required to assess this target for intervention in clinical and at-risk individuals.

Chapter 3

Empirical Study 2:

IDENTIFYING THE BEHAVIOURAL CORRELATES OF ALEXITHYMIA IN ADULTS: FINDINGS FROM AN EMOTIONAL EXPRESSION MORPH PARADIGM

3.1. Introduction

The findings from the previous chapter identified a unique contribution of the TAS-20 subfactor, DIF, in the relationship between experiences of childhood trauma and later-life depressive/anxiety symptoms. To elaborate on these findings, the next aim of this thesis was to assess potential behavioural correlates of alexithymic traits in individuals from the general population by administering a novel emotional expression morph paradigm. Furthermore, it was of interest to ascertain if alexithymia remains a significant predictor of emotional processing deficits when potentially co-occurring depressive/anxiety symptoms are controlled for.

As discussed in Chapter 1 Section 1.3.2, the literature regarding alexithymia's influence on emotion recognition abilities has been heterogeneous. A possible explanation for the inconsistent findings has been the use of "artificial social stimuli" (Joormann & Gotlib, 2006, p.706). Stimuli selected for use in emotion recognition tasks are typically static images of posed emotional facial expressions at far higher emotional intensities than what would be expected in everyday life. These stimuli are often presented to participants in labelling tasks, in which participants are given unlimited time to view the images and select which emotion they believe is being expressed. While these methodologies have been successful in

identifying emotion recognition deficits in individuals with marked psychopathology, labelling tasks are often subject to ceiling effects even in young populations (Thomas, De Bellis, Graham & LaBar, 2007). Furthermore, important information regarding the individual's emotion recognition abilities may be undetected using static, fully-expressed stimuli. Therefore, it may be speculated that labelling tasks would fail to detect subtle emotion recognition deficits in individuals with sub-threshold levels of psychopathological symptoms.

In a review article by Grynberg and colleagues (2012), the authors suggested that alexithymic individuals may not exhibit difficulties in detecting, matching and labelling emotional expressions *per se*. Rather, the association between alexithymia and emotion recognition difficulties may be due to discrete emotion processing deficits. When presented with emotive stimuli for a long duration (e.g., ten seconds) alexithymic adults have been found to perform similarly to controls in labelling tasks (Mann et al., 1995; Pandey & Mandal; 1997). However, in studies that have presented stimuli for shorter durations (e.g., 33 to 1000 milliseconds), a significant effect of alexithymia on emotion recognition was identified (Pedrosa Gil et al., 2009; Prkachin, Casey & Prkachin, 2009; Reker et al., 2010). As such, Grynberg and colleagues (2012) concluded that while alexithymic individuals may have intact emotion *recognition*, they may experience discrete deficits in their emotion *processing* abilities. In light of this, the authors recommended using the Emotional Expression Multimorph Task (henceforth EEMT; Blair, Colledge, Murray & Mitchell, 2001). The EEMT involves participants being presented with an emotionally neutral face which gradually morphs over successive frames (typically in 5% or 2.5% increments) into one of six target emotions; sadness, happiness, anger, fear, disgust and surprise (Blair et al., 2001). When the participant recognises the emotion, a button is pressed and their answer is chosen from a selection of possible emotions. Proponents of the task suggest this has a number of

methodological strengths. First, the EEMT may be a more ecologically valid assessment of emotion recognition difficulties as emotions are typically not expressed to full intensity in everyday life (Joorman & Gotlib, 2006). Second, the task generates a 'sensitivity' score (i.e., how many morph frames are required for the participant to correctly recognise the target emotion) which may act as a proxy measure for emotion processing speed (Rosenberg, Dethier, Kessels, Westbrook & McDonald, 2015). Lastly, as the task is more cognitively demanding than more traditional methodologies, subtle emotion recognition deficits may be identified in otherwise healthy samples (Battaglia et al., 2010).

3.1.1. *Use of Morphing Paradigms in Emotion Recognition Tasks*

Considering the methodological strengths of the EEMT, a recent trend in emotion recognition studies has been the administration of morphing paradigms, most notably in MDD patients. Supporting the findings of Dalili and colleagues' meta-analysis (2015), individuals with recurrent depressive episodes have been found to be significantly less sensitive towards happy expressions compared to healthy controls, whereas no significant differences on sad and anger sensitivity were identified between the two groups (LeMoult, Joormann, Sherdell, Wright & Gotlib, 2009; Coupland et al., 2004). These findings are in accordance with Harmer and colleagues (2009), where MDD patients treated with a placebo were significantly less sensitive to happy expressions compared to those treated with the SNRI (serotonin noradrenaline reuptake inhibitor) reboxetine, even when controlling for co-occurring anxiety symptoms (Harmer et al., 2009). Interestingly, the use of antidepressants appears to significantly influence the negative cognitive bias within nonclinical samples with elevated depressive symptoms. In a study conducted by Bamford and colleagues (2015), healthy individuals treated with a two-week course of duloxetine were found to be significantly less sensitive towards sad faces than those administered with a placebo.

Findings have been relatively heterogeneous in clinically anxious populations. While some authors have identified significantly faster reactions towards angry (Maoz et al., 2016) and fearful (Zhou & Chen, 2009) faces, some investigators have failed to corroborate this finding (Philippot & Douilliez, 2005). Interestingly, as well as a threat-related cognitive bias, one previous study identified a significantly slower reaction towards a happy morph compared to healthy controls, a finding more commonly associated with depressed individuals (Maoz et al., 2016). It is possible that the use of morphing paradigms may illuminate subtle emotional processing deficits undetectable with more classic labelling-paradigms. However, it is worthy to note Maoz and colleagues (2016) did not measure co-occurring depressive symptoms in their study population of socially anxious patients. As such, the study requires replicating, measuring both depressive and anxiety symptoms in tandem within the same population.

To date, only one study has assessed the influence of alexithymia on the performance in a morphing paradigm in healthy adults. Results from the recent study conducted by Starita, Borhani, Bertini & Scarpazza (2018) found healthy alexithymic individuals to be less sensitive to fearful face morphs than non-alexithymic participants. However, the study is not without a number of limitations. Firstly, a relatively small sample size was tested (n = 40), therefore the findings may not be applicable to the wider populace. Secondly, the emotional expression morphs only consisted of 6 successive frames (i.e., each frame representing 20% emotional intensity). As there was a relatively large discrepancy in emotional intensity between the morph frames, an accurate assessment of the emotional processing deficits may not have been detected with the other target emotions. Thirdly, the authors did not parse the TAS-20 scores into its proposed subfactors to investigate their potential contributions to task performance. This is of concern considering previous studies have identified differing unique contributions of the subfactors (e.g., DIF, Kugel et al., 2008; EOT, Prkachin et al., 2009) in

emotion recognition task performance. Lastly, potentially co-occurring depressive and anxiety symptoms were not measured nor controlled for in the study's analysis.

3.1.2. *The Current Study*

Currently, there is a large body of evidence suggesting depression and anxiety significantly impact on the processing of emotional facial expressions, across a wide continuum of symptom severity (Lazarov et al., 2018). However, a considerably smaller body of research has been produced examining the effects of alexithymia on emotional stimuli processing. Furthermore, while the three psychological phenomena have been found to be closely linked (Marchesi et al., 2000), the contributions of each psychological construct on potential emotional processing deficits remain unclear. Addressing the significant methodological limitations of Starita and colleagues'(2018) study, the current empirical chapter will be the first to adequately investigate if alexithymia has an independent effect on emotional facial expression processing in individuals from the general population using the EEMT. This will be done by correcting for potentially co-occurring depressive/anxiety symptoms in the main analyses. The next aim of the chapter is to assess if the TAS-20 subfactors differ significantly in their contributions towards EEMT performance.

3.2. Methods

3.2.1. *Participants*

A total of 96 adults participated in the current study. Three methods were used during participant recruitment. Firstly, a study invitation email was sent to both the Edinburgh University Psychology department's faculty members and postgraduate students. Secondly, the study was advertised on an undergraduate subject pool in which students participate in experimental studies for course credit. Lastly, the study was advertised on social media

networks. The sample consisted of 27 male and 70 female participants, with a mean age of 27.71 (SD = 13.79). Participant age ranged from 18 to 72 years old.

Prior to completing the experimental task, participants were asked to provide information on their mental health status and any psychotropic mediation they were currently taking. Two participants had been formally diagnosed with MDD, with a further five diagnosed with both MDD and comorbid generalized anxiety disorder (GAD). A further one participant had obsessive compulsive disorder (OCD). Six out of the eight participants with a formal psychiatric diagnosis were using selective serotonin reuptake inhibitors.

As some of the participants had a formal psychiatric diagnosis, an exclusion criterion was implemented in which those with both MDD and a BDI score above 29 (cut-off for severe depressive symptoms; Beck, Steer & Brown, 1996) were excluded from the analysis. One participant was identified as having a BDI score of 35 and was therefore removed from the dataset, resulting in a sample size of 95.

3.2.2. *Measures*

3.2.2.1. The Toronto Alexithymia Scale (TAS-20)

A full overview of the TAS-20 can be seen in Chapter 2 Section 2.2.1.1. Within the context of experimental procedures, a common method to identify alexithymic individuals is to use a cut-off of 1.5 standard deviations above the mean (Swart et al., 2009; Pandey & Mandal, 1997; Lane, Sechrest, Riedel, Shapiro & Kaszniak, 2000). Within this sample, this gave a TAS-20 cut-off score of 60. It was found 10 (10.50%) participants were identified as 'high alexithymia' (> 60; 'HA') and 85 (89.50%) identified as 'low alexithymia' (< 59; 'LA').

3.2.2.2. Beck's Depression Inventory – II (BDI-II)

The Beck's Depression Inventory second edition (BDI-II; Beck et al., 1996) is a 21-item self-report instrument used to examine depressive symptoms experienced over the last two weeks. The measure is considered a valid and reliable measure for depression screening in both clinical and nonclinical samples (Whisman, Perez & Ramel, 2000) with high sensitivity (.730) and specificity (.844) (Shean & Baldwin, 2008). Furthermore, the BDI-II has been found to have good internal consistency ($\alpha > .900$; Storch, Roberti & Roth, 2004). Items consist of statements of increasing symptom severity (e.g., "I do not feel I am worthless" to, "I feel utterly worthless") and are rated on a 4 point scale of symptom severity (0-3), with a score range of 0 to 63. Completion of the BDI-II took approximately six minutes. Higher scores are indicative of more severe depressive symptoms. Cut offs scores for the BDI have been established at 0 – 13 = minimal depression, 14 – 19 = mild depression and 20 – 28 = moderate depression. Within the study's sample, 70 (73.60%) had minimal depressive symptoms, 15 (15.80%) had mild depressive symptoms and 10 (10.60%) had moderate depressive symptoms.

3.2.2.3. State Trait Anxiety Inventory (STAI)

State Trait Anxiety Inventory (STAI; Spielberger, Goruch & Lushene, 1970) is a widely used measure of state and trait anxiety symptoms. The measure has been found to have good internal consistency ($\alpha > .900$; Grös, Antony, Simms & McCabe, 2007). The state anxiety subscale ("STAI-State") asks participants to rate 20 items (e.g., "I feel worried") on their feelings of anxiety at the time of completing the measure. The trait anxiety subscale ("STAI-Trait") asks participants to rate 20 items (e.g., "I feel nervous and restless") on how they felt generally. The item is scored on a four point scale, with 1 = 'Not At All' to 4 = 'Very Much So'. Scores ranged from 20 to 100 for each subscale. Completion of the STAI took

approximately eight minutes. Currently, no definitive cut-off scores have been established for the STAI. However, it has been proposed scores above 41 for the STAI-S (sensitivity = .781; specificity = .712) and 44 for the STAI-T (sensitivity = .935; specificity = .574) can be used to identify clinically significant levels of anxiety (Ercan, Hafizoglu, Ozkaya & Akaya, 2015). Using these cut-offs, 28 (29.40%) participants had elevated state anxiety symptoms and 33 (34.70%) participants had elevated trait anxiety symptoms.

3.2.2.4. Emotional Expression Multimorph Task (EEMT)

An adapted version of the original Emotional Expression Multimorph Task by Blair and colleagues (2001) was developed for the current study. Stimuli were taken from the validated Radboud Faces Database (Langner et al., 2010). Images of six actors (three male) expressing the six basic emotions; happy, fear, anger, surprised, sad, disgust and neutral were selected from the database. The original colour images were converted to grayscale and the faces of the actors were cropped into an ovoid shape (105mm x 120mm) in order to remove extraneous information such as the actors' hair and clothing. Image manipulation was made using the GNU Image Manipulation Programme, version 2.8.2 (http://www.gimp.org). After preparing the images, the actors' neutral expressions were morphed into the emotionally expressive face for each of the six emotion categories using the software WinMorph version 3.01 (http://www.debugmode.com/winmorph). The morphs consisted of 40 images, from 0% to 100% emotional intensity, across 2.5% increments. The experimental paradigm was developed using the stimuli presentation software OpenSesame version 3.1 (Mathôt, Schreij & Theeuwes, 2012). Each morph iteration was presented for 100ms as this presentation time has been found to be sufficiently long enough for emotion expression recognition to occur without causing ceiling effects (Calvo & Marrero, 2009). Each emotional category was presented randomly six times, giving a total of 36 trials. Furthermore, the gender of the actors was randomised across emotional morph presentation. Three practice trials preceded the main

experimental task. The task was completed on a 22" computer screen, approximately 60cm away from the participants. Completion of the EEMT took approximately twelve minutes.

3.2.3. *Procedure*

On entering the laboratory, participants were seated in a quiet, well-lit room and provided with an information sheet. After being informed of the experimental task, individuals were provided with a consent form and a questionnaire booklet containing the psychometric measures (see Appendix 2 Section A2.1). The anonymity of the questionnaire was stressed to participants as their data was only identifiable via a participant number and they were informed they may leave any item(s) blank without consequence. On finishing the booklet, participants were then asked to take part in a computer task, in which they would view neutral faces that would morph into one of the six emotions presented on the electronic instruction sheet. They were requested to press the space bar as soon as they recognised the emotion being expressed, without merely guessing. This would bring up a separate screen, where they could input their answer from a multiple choice list. Participants could change their mind at any point during the morphing process and change their answer, as many times as they would like. When the morph reached 100% emotional intensity, participants were asked to give a final answer to verify their response (see Figure 3.1 and Appendix 2 Section 2.2). The experimenters advised participants they would not receive feedback on their task performance. On completion, participants were debriefed on the experimental aims of the study and reimbursed £8. Data was analysed using SPSS software version 22 (IBM Corporation, Armonk, NY, USA). Ethical approval was obtained from the University of Edinburgh Research Ethics Committee (94-1718/2).

3.2.3.1. Scoring the EEMT

The two primary outcome measures used in previous investigations (Blair et al., 2001; Blair et al., 2004) were the participants' average sensitivity and overall accuracy score.

Sensitivity towards the six target emotions was calculated by averaging the response point required for correct recognition. A higher score was indicative of a slower identification, thus a decreased sensitivity towards the target emotion. As recommended by Berg and colleagues (2016), the morph response point was coded as no response for incorrect responses. If an incorrect identification was inputted at morph frame 10 but corrected at frame 20, the response point was entered as 20. If an incorrect input remained uncorrected, the trial was considered inaccurate and was not included when the average sensitivity score for the six emotions was calculated. This gave the participant's average frame response (AFR) score. The second outcome was overall accuracy (OA), in which the number of correct identifications of the target emotions when the morph reached 100% intensity were summed together to give a total accuracy score (across all six emotions) and a target emotion accuracy score (for each emotion). A third outcome, used by Rich and colleagues (2008) and Berg and colleagues (2016) was the first response accuracy (FRA) score. That is, trials were scored as correct when both a correct identification was given during the morph presentation and a correct response when prompted for a final answer. Trials with an incorrect response during the morph presentations irrespective of a correct final answer were considered incorrect.

3.2.4. *Statistical Analysis*

After cleaning the data of missing variables from the questionnaires and identifying any multivariate outliers, descriptive analyses were conducted to assess psychometric measure and task performance score distributions. In order to identify confounding variables for the later analysis, correlational analyses and independent sample t-tests bootstrapped with 5000 iterations were computed in order to identify any significant influences of participant demographics on task performance scores. Multivariate general linear models were run in order to identify significant group differences between the participants above the cut-offs established for the TAS-20, BDI and STAI on OA, FRA and AFR scores.

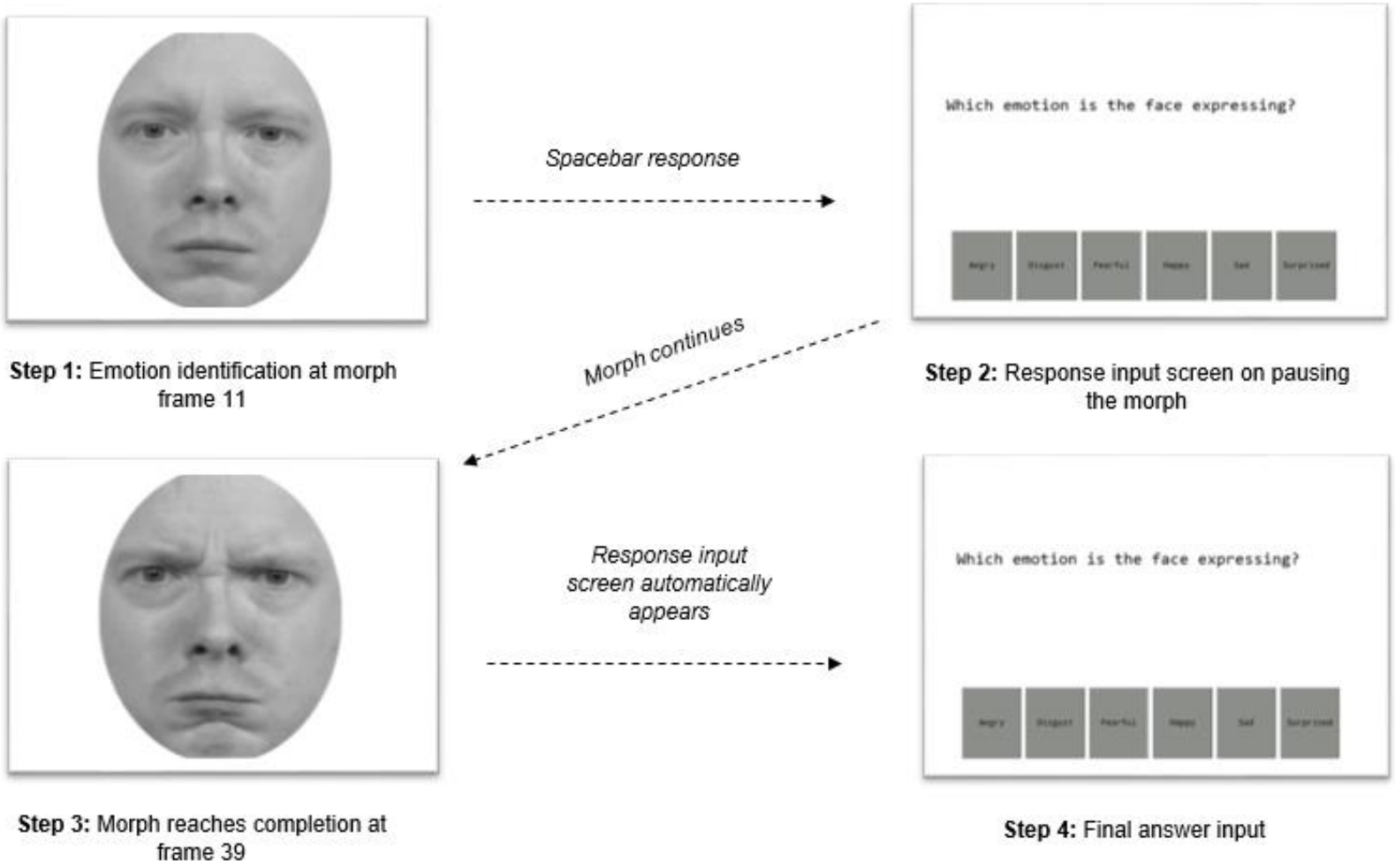

Figure 3.1. *Screenshots of the EEMT, demonstrating task procedure.*

The TAS-20 scores were then divided into the proposed alexithymia constructs DIF, DDF and EOT and regression analysis was run in order to identify any significant predictor(s) of EEMT performance. Multicollinearity was assessed using a Durbin Watson statistic and variance inflation factors (VIFs). A Durbin Watson statistic between 1.50 and 2.50 and a VIF under 10 were considered acceptable (Farrar & Glauber, 1967).

3.3. Results

3.3.1. *Data Cleaning*

Before conducting the main analysis, the extent of missing data was assessed. An *a priori* missing data rule was implemented, in which participants with more than four missing data points were excluded from the data analysis. For the laboratory questionnaire data, it was discovered five participants left one item of the TAS-20 out, with a further one participant missing three items. A further three participants left out between one and four items of the BDI. No participants left out items from the STAI. Therefore, the average item scores were inserted into the missing data points in order for full scores to be generated. None of the participants were excluded from the dataset. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. Lastly, in order to identify any multivariate outliers, Mahalanobis' distances were calculated on both the psychometric measure total scores and task performance scores. With the critical alpha set at $p < .001$, it was found no participants were above the critical value of 18.47 for the psychometric measure total scores or 22.46 for the task performance scores. Therefore, no participants were removed from the dataset. This gave a final sample size of 95.

3.3.2. *Descriptive Analysis*

3.3.2.1. Psychometric measure score distribution

Prior to the main analysis, the means, standard deviations and score ranges of the psychometric measures were calculated (see Table 3.1).

Table 3.1.

Means, standard deviations and score ranges of the key psychometric measures.

Measure	Mean	SD	Range
TAS-20	45.42	9.98	24 – 72
BDI	9.18	7.09	0 – 27
STAI-T	40.07	12.09	20 – 64
STAI-S	35.11	11.04	20 – 71

Note. TAS-20: Toronto Alexithymia Scale -20, BDI: Becks Depression Inventory, STAI-T: State Trait Anxiety Inventory – Trait subscale, STAI-S: State Trait Anxiety Inventory – State subscale.

3.3.2.2. EEMT performance.

In order to assess the participants' performance on the EEMT, the average scores were generated for the three main experimental outcomes (see Table 3.2). Happiness was the most easily identified, with 99.67% overall responses and 99.00% of first responses correct. Additionally, happy faces took the shortest time to correctly identify, with an AFR score of 12.87 (approximately 1287 milliseconds). In contrast, fearful faces were the least accurately recognised, with 80.00% overall responses and 68.83% first responses correct. Fearful faces also took the longest to correctly recognise, with an AFR score of 27.62 (approximately 2762 milliseconds).

On inspection of the differences between overall and first response accuracy, a significant difference was found between the total scores ($t(190) = 4.59$, $p < .001$). Furthermore, participants were significantly less likely to correctly identify fear on their first

response compared to their overall accuracy ($t(190) = 4.12$, $p < .001$). No other significant differences between overall and first response accuracy scores were identified.

Table 3.2.

Average performance on the Emotional Expression Multimorph Task

Emotion	Metric	Mean	SD	Range (%)	OA/FRA Difference (t)
Anger	% OA	80.17	1.13	33 – 100	1.06
	% FRA	76.00	1.18	16 – 100	
	AFR	23.09	4.83	12 – 39	
Disgust	% OA	83.66	1.06	33 – 100	1.28
	% FRA	76.17	1.14	33 – 100	
	AFR	22.18	5.24	12.6 – 34	
Fear	% OA	80.00	1.02	33 – 100	4.12***
	% FRA	68.83	1.21	0 – 100	
	AFR	27.62	4.26	16.3 – 39	
Happy	% OA	99.67	.10	83 – 100	1.43
	% FRA	99.00	.27	66 – 100	
	AFR	12.87	3.40	7 – 23.5	
Sad	% OA	92.83	.66	50 – 100	1.10
	% FRA	89.17	.83	33 – 100	
	AFR	25.09	4.68	15 – 37	
Surprised	% OA	80.53	.95	16 – 100	.59
	% FRA	77.17	.98	16 – 100	
	AFR	20.46	5.27	11 – 36.7	
Overall	*% OA*	*86.11*	*2.44*	*64 – 97*	4.596***
	% FRA	*81.11*	*2.87*	*55 – 94*	
	AFR	*130.93*	*19.70*	*91 – 192*	

Note. OA: Overall Accuracy, FRA: First Response Accuracy, AFR: Average Frame Response, SD: Standard deviation. ***p <.001.

3.3.3. *Gender and Psychiatric Diagnosis Effects on Task Performance*

Bootstrapped independent sample t-tests revealed a significant gender effect on total emotion recognition accuracy score, with female participants better at correctly recognising emotions than males ($t(37.27) = -2.69$, $p = .011$). Furthermore, females required significantly fewer morph iterations to correctly identify the target emotions ($t(93) = 2.20$, $p = .030$). At the individual emotion level, females were more likely to correctly identify angry ($t(38.86) = -2.79$, $p = .003$) and disgusted faces ($t(93) = -3.82$, $p < .001$) compared to males. Females were also found to be significantly more sensitive to disgusted faces ($t(93) = 3.09$, $p = .003$). No significant gender effect was found on angry, fearful, sad, surprised and happy accuracy or sensitivity scores.

Psychiatric illness status was found to have a non-significant effect on the total AFR score ($t(93) = 1.07$, $p = .288$). However, at the individual target emotion level, participants with a formal psychiatric diagnosis were found to be more sensitive to disgusted faces ($t(14.301) = 4.84$, $p < .001$). No other significant effect of psychiatric diagnosis was found in task performance scores.

3.3.3.1. Gender and psychiatric diagnosis effects on TAS-20, BDI and STAI scores

Bootstrapped independent sample t-tests revealed no significant gender effect on TAS-20, BDI, STAI-T or STAI-S scores. Participants with a formal psychiatric diagnosis rated themselves significantly higher on BDI ($t(93) = -5.75$, $p < .001$), STAI-T ($t(93) = -4.89$, $p < .001$) and STAI-S ($t(93) = -4.33$, $p < .001$), however no significant psychiatric diagnosis status effect was found on TAS-20 scores.

3.3.4. *Correlational Analyses*

3.3.4.1. Correlations between the psychometric measures and participant age

Pearson's correlations were run in order to establish significant relationships between the psychometric measures. All measures correlated significantly, with TAS-20 scores significantly correlating with BDI ($r = .477$, $p < .001$), STAI-T ($r = .524$, $p < .001$) and STAI-S ($r = .491$, $p < .001$) scores, BDI scores correlating significantly with STAI-T ($r = .837$, $p < .001$) and STAI-S ($r = .732$, $p < .001$) scores and both STAI-T and STAI-S correlating significantly ($r = .856$, $p < .001$). Participant age was also found to correlate significantly negatively with TAS-20 ($r = -.208$, $p = .042$), BDI ($r = -.280$, $p = .006$), STAI-T ($r = -.304$, $p = .003$) and STAI-S ($r = -.316$, $p = .002$) scores.

3.3.4.2. Correlations between the psychometric measures, participant age and task performance scores

After establishing significant correlations between the psychometric measures, further correlations were run in order to investigate any significant relationships between TAS-20, BDI and STAI scores of task performance. No significant correlations were found between the psychometric measures and overall or first response accuracy scores, either at the total or target emotion level. TAS-20, BDI, STAI-T and STAI-S scores were found to correlate significantly with the Happy-Frame scores ($r = .341$, $p = .001$; $r = .264$, $p = .009$; $r = .334$, $p = .001$; $r = .293$, $p = .004$, respectively). Additionally, BDI scores also correlated significantly negatively with Sad-Frame scores ($r = -.238$, $p = .020$).

3.3.5. *The Effect of Alexithymia, Depressive Symptoms and Anxiety on Accuracy (OA and FRA) Scores*

The potential effects of alexithymia, depressive symptoms and anxiety on the EEMT accuracy scores were assessed using three one-way MANCOVAs. Participant age, gender

and psychiatric diagnostic status were entered in as covariates. Box M Tests were above the proposed cut-off of p >.001 (Barton, Yeatts, Henson & Martin, 2016; Huberty & Lowman, 2000), suggesting equality of covariance between the groups. In regards to OA scores, no main effects of alexithymia (Λ = .982, F(7, 86) = .233, p = .976, η2p = .018), depressive symptoms (Λ = .842, F(12, 168) = .221, p = .221, η2p = .082), trait anxiety (Λ = .931, F(6, 88) = .1.09, p = .377, η2p = .069) or state anxiety (Λ = .900, F(6, 88) = .1.63, p = .148, η2p = .100) were identified. Furthermore, no significant main effects of alexithymia (Λ = .985, F(6, 86) = .229, p = .966, η2p = .015), depressive symptoms (Λ = .873, F(12, 168) = 1.02, p = .437, η2p = .065), trait anxiety (Λ = .919, F(6, 86) = 1.29, p = .270, η2p = .081) or state anxiety (Λ = .969, F(6, 86) = .468, p = .830, η2p = .031) were found on FRA scores.

3.3.6. *The Effect of Alexithymia, Depressive Symptoms and Anxiety on Sensitivity (AFR) Scores*

After assessing the effects of the key variables on accuracy scores, the potential effects of alexithymia, depressive symptoms and anxiety on emotional expression sensitivity was assessed using further one-way MANCOVAs. As participant demographics were found to significantly associate with task performance, participant age, gender and psychiatric diagnoses were inserted into the models as covariates. Box M Tests were above the proposed cut-off of p >.001 (Barton et al., 2016; Huberty & Lowman, 2000), suggesting equality of covariance between the groups. The multivariate analyses revealed reliable main effects of alexithymia (Λ = .866, F(6, 86) = 2.26, p = .020, η2p = .156), depressive symptom (Λ = .768, F(12, 168) = 2.05, p = .023, η2p = .124) and trait anxiety (Λ = .756, F(6, 86) = 4.73, p < .001, η2p = .244) group scores on task performance. State anxiety showed no significant main effect (Λ = .877, F(6, 86) = 1.69, p = .078, η2p = .119).

Following the multivariate analyses, univariate *F* tests were conducted to assess each of the emotion expression morph performances. Both alexithymia and depressive symptoms were found to be significantly associated with higher total AFR scores ($F(1,90) = 6.81$, $p = .011$, $\eta 2p = .070$; $F(2,89) = 4.73$, $p = .009$, $\eta 2p = .096$, respectively). Trait anxiety however had no significant effect on total AFR scores ($F(1,90) = 3.75$, $p = .056$, $\eta 2p = .040$).

At the individual target emotion level, HA individuals were significantly less sensitive towards happy faces ($F(1, 90) = 14.14$, $p = .002$, $\eta 2p = .133$). Similarly, individuals with elevated depressive symptoms were significantly less sensitive towards happy faces ($F(2, 89) = 6.44$, $p = .002$, $\eta 2p = .122$). While a significant correlation emerged between BDI and sad AFR score ($r = -.238$, $p = .020$), this effect diminished within the univariate *F* tests ($F(2, 89) = 1.88$, $p = .158$, $\eta 2p = .039$). Lastly, individuals high on trait anxiety were also significantly less sensitive to happy faces ($F(1, 90) = 15.70$, $p < .001$, $\eta 2p = .144$) and significantly more sensitive to angry faces ($F(1, 90) = 5.29$, $p = .024$, $\eta 2p = .054$). A summary of the findings can be seen in Table 3.3.

3.3.7. *Regression Analyses*

Prior to conducting regression analysis, DIF, DDF and EOT subfactor scores were generated and correlations were run in order to identify any significant relationships between the subfactors, BDI, STAI-T and task performance scores. DIF and DDF correlated significantly with BDI ($r = .643$, $p < .001$; $r = .357$, $p < .001$, respectively) and STAI-T ($r = .669$, $p < .001$; $r = .399$, $p < .001$, respectively) scores. Furthermore, DIF and DDF correlated significantly with HappyFrame scores ($r = .324$, $p < .001$, $r = .265$, $p = .010$, respectively). The subfactor EOT was found to share no significant correlations with the other variables.

After establishing significant correlations, a multiple step-wise linear regression was conducted in order to identify which of the key variables(s) explained a significant degree of

Table 3.3.

Summary of findings from correlations and multivariate general linear models on EEMT average frame response scores, controlling for participant demographics.

Main Effect?	Target emotion average frame response scores						
	Anger	Disgust	Fear	Happy	Sad	Surprise	*Total*
TAS-20**:Yes**	*.103*	*.105*	*-.018*	*.341****	*-.036*	*.061*	*.114*
(2.26*)				(14.14**)			(6.81*)
BDI**: Yes**	*.003*	*-.170*	*-.150*	*.264***	*238**	-.063	*-.104*
(2.05*)				(6.44**)			(4.73**)
STAI-T**: Yes**	*-.178*	*-.175*	*-.049*	*.334****	*-.186*	*-.005*	*.003*
(4.73***)	(5.29*)			(15.70***)			
STAI-S: **No**	.071	*-.094*	*-.002*	*.223**	*-.122*	*.001*	*.039*
(1.69)							

Note. TAS-20: Toronto Alexithymia Scale -20, BDI: Becks Depression Inventory, STAI-T: State Trait Anxiety Inventory – Trait subscale, STAI-S: State Trait Anxiety Inventory – State subscale. Main effect F values denoted by parentheses. Pearson correlation coefficients denoted by italics. *p <.05, **p <.01, ***p <.001.

variance in happy response frame score. Gender, age and psychiatric illness diagnosis status were entered into the model first in order to control for any variance explained by participant demographics. Results are shown in Table 3.4. DIF emerged as the only significant predictor of happy response frame score, explaining 10% of the variance ($\beta = .329$, $p < .001$). Depressive symptoms ($\beta = .038$, $p = .794$), trait anxiety ($\beta = .210$, $p = .160$) and DDF ($\beta = .150$, $p = .224$) were excluded from the final model as the variables did not explain a significant degree of variance. Furthermore, participant demographics did not contribute significantly to the regression model. Autocorrelation between the residuals were not considered a significant issue as the regression analysis produced a Durbin Watson statistic of 2.33 (see Appendix 2 Section A2.3 for regression plots).

Table 3.4.

Multivariate linear regression analysis with happy response frame score as the dependant variable.

Step	Predictor Variables	β	t	VIF	R^2	ΔR^2	*F*
1	Gender	.016	.016	1.057	.024	.024	.745
	Age	.084	-.084	1.059			
	PsychIllness	.136	.136	1.012			
2	Gender	.092	.884	1.116	.124	.100	3.172*
	Age	-.055	-.535	1.068			
	PsychIllness	.084	.831	1.039			
	DIF	.329	3.198***	1.088			

Note. PsychIllness: Psychiatric illness diagnosis, DIF: Difficulty Identifying Feelings, VIF: variance inflation factor. *p <.05, ***p <.001.

3.4. Discussion

It has been previously established depressive and anxiety symptoms are associated with marked biases towards emotional expression recognition, both in clinical (Dalili et al., 2015; McClure et al., 2007) and non-clinical (Laeger et al., 2012; Surcinelli et al., 2006) populations. While sharing high comorbidity, the two psychological constructs have been found to influence emotional expression processing in unique ways. Supporting the theory of Beck (1976), depressive symptoms have been found to be more associated with biases towards the 'affect continuum'; that is, towards positive (i.e., happiness) and negative (i.e., sadness) emotional expressions (Duque & Vázquez, 2015; Gotlib et al., 2004). In contrast, anxiety is classically associated with biases towards the 'threat continuum'; that is, towards threatened (i.e., fearful) and threatening (i.e., angry) emotional expressions (Dalgleish et al., 2001). However, a consistent limitation of the previous literature has been the failure to measure co-occurring alexithymic traits in the tested populations. Considering previous

investigations have illuminated alexithymia's significant influence on emotion recognition and processing (Swart et al., 2009; Starita et al., 2018), it remains unclear if alexithymic traits remain a significant predictor of emotional processing difficulties if co-occurring depressive/anxiety symptoms are taken into account. Furthermore, the majority of the previous studies have relied on rudimentary emotion-labelling paradigms which may be sensitive to ceiling effects in healthy populations (Thomas et al., 2007). As such, there have been calls to use more cognitively demanding tasks when assessing emotion stimuli processing (Grynberg et al., 2012), such as the EEMT (Blair et al., 2001). Therefore, the main aim of this empirical chapter was to assess the potential effect(s) of alexithymia, independent of depressive and anxiety symptoms, on EEMT performance in a sample of adults from the general population.

3.4.1. *Global Emotional Processing*

It was first of interest to assess if alexithymia, depressive and/or anxiety symptoms were associated with differences in global emotional processing. That is, if individuals with marked symptoms of psychopathology required significantly more or fewer frames in the morphing stimuli before correct recognition occurred. Results from the linear models revealed both elevated alexithymia and depressive symptoms were associated with a significantly higher total response frame score. Heightened trait anxiety however showed no significant effect on total response frame score. From a theoretical perspective, these findings are in partial support of the motivational bias theory, put forward by Mogg, Bradley and Williams (1995). The authors speculated depressed individuals are characterised by a decreased motivation to seek out emotionally salient information. That is, depression is associated with *hypo*-motivation towards emotional expression processing. Considering depressive symptoms and alexithymia may share similar maladaptive cognitive processes (Taylor et al., 1999), global emotional processing impairment has been seen in both

depressive (Wexler, Levenson, Warrenburg & Price, 1994) and alexithymic (Ridout, Thom & Wallis, 2010) individuals. In contrast, anxious individuals' hypervigilance towards potential threat may be an artefact of their increased readiness to orientate their attention towards negative affect. As the authors suggest anxiety is associated with *hyper*-motivation, it would be predicted anxious individuals would have a significantly lower total AFR score (Mogg et al., 1995). However, the current study found no significant differences between subclinical anxious and non-anxious participants. Therefore, it may be speculated that *global* hyper-motivation towards emotional expression processing may only be detected in clinically relevant anxiety symptoms. Supporting this notion, socially anxious patients have been found to have a significantly lower threshold for identifying all six basic emotions compared to nonanxious controls when presented with emotional expressions in 10% intensity increments (Button, Lewis, Penton-Voak & Munafò, 2013).

3.4.2. *Emotion-Specific Processing*

Despite this, emotion-specific biases were identified in individuals with heightened alexithymia, trait anxiety and depressive symptoms. Congruent with the previous literature, trait anxiety was found to be exclusively associated with increased sensitivity towards threatening faces. That is, anxious individuals required significantly fewer frames in the angry face morphs before a correct recognition of the emotion occurred. This has been a consistent finding throughout the majority of previous investigations, both in clinical and nonclinical (Carré et al., 2013) levels of trait anxiety severity. However, no significant effect was identified on fear AFR score. Considering the literature has been heterogeneous regarding subclinical anxiety's effect on fear sensitivity (Surcinelli et al., 2006; Cooper, Rowe & Penton-Voak, 2008), this is a somewhat unsurprising finding. As such, it may be speculated that a significant attentional bias towards one side of the threat continuum (i.e., *threatening* stimuli) can be observed in anxious, but otherwise healthy individuals. Observing

the full threat-continuum (i.e., sensitivity towards both anger and fear) may be limited to those with clinically relevant trait anxiety symptoms, as found in previous findings in clinical populations (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & Van Ijzendoorn, 2007 for review).

However, all three of the psychological phenomena assessed were found to significantly influence the processing of happy emotional expressions. Within the context of depressive symptoms, results from the current study also lend partial support for the "affect continuum" theory (Beck, 1976). That is, those with elevated depressive symptoms required significantly more frames in the happy frame morphs before correct recognition occurred. While a significant negative correlation between BDI score and sad response frame was identified, this association diminished in the study's general linear models. These results are in accordance with the meta-analysis conducted by Dalili and colleagues, discussed earlier in this chapter (Dalili et al., 2015). This finding may be, at least in part, explained by anhedonia. Anhedonia, the reduced ability to experience pleasure, is a key component of depressive symptoms both at the clinical and subclinical levels of severity (Liu et al., 2016; Franken, Rassin, Muris, 2007). It may be speculated those who have difficulties deriving happiness themselves may in turn be significantly less sensitive towards the happiness of others. In a previous investigation conducted by Stuhrmann and colleagues (2013), the authors discovered elevated anhedonia in MDD patients was associated with the reduced activation of the amygdala when the patients were presented images of happy expressions. As such, the attenuation away from positive affect may be an epiphenomenon of depressive symptoms, across the severity continuum. Likewise, a main effect of trait anxiety was also found on happy AFR score, similar to the findings of Maoz and colleagues (Maoz et al., 2016). Two possible explanations for this finding are as follows. First, considering a high comorbidity of depressive and anxiety symptoms has been found even in the general population (Pirkola et

al., 2005), and the current study measured depressive and anxiety symptoms concurrently in the tested sample, overlaps in emotion-specific processing deficits were detected. Secondly, regarding the threat continuum associated with anxiety, it may be possible it is reduced from threatening (i.e., angry) to non-threatening (i.e., happy) in subclinical individuals. However, future studies are required to confirm this speculation.

As depressive and anxiety symptoms shared highly significant correlations with alexithymic traits ($r = .477$; $r = .524$, respectively) it is unsurprising alexithymia was also associated with a significant attenuation away from positive affect. While this finding has not been unanimous across the previous body of literature, a significant influence of alexithymic traits on happy face processing has been detected, primarily in neuroimaging paradigms (Reker et al., 2010; Kano et al, 2003). In contrast, previous emotional-labelling and –matching tasks have failed to detect associations between alexithymia and happy expression processing deficits (Mann et al., 1995; Galderisi et al., 2008). As such, the results from the current study suggest the use of morphing paradigms may illuminate otherwise undetectable deficits in alexithymic individuals, previously limited to neuroimaging studies.

Considering all three of the psychological phenomena assessed showed associations with an attenuation away from positive affect, it was lastly of interest to identify which of the construct(s) predicted a significant degree of variance in happy AFR scores. Results from the regression analysis revealed an exclusive role of alexithymia, specifically DIF, on an individual's attenuation away from positive affect. Neither co-occurring depressive nor anxiety symptoms explained a significant degree of variance in the regression model, a finding similar to previous emotion-labelling and –matching paradigms (Pedrosa Gil et al., 2009). While the literature is scarce regarding the unique contributions of the three alexithymia components, previous neuroimaging have identified a unique contribution of the

DIF subfactor on emotional processing deficits (Duan, Dai, Gong & Chen, 2010; Kugel et al., 2008).

3.4.3. *Emotional Expression Processing Versus Recognition*

Interestingly, no significant effects of any of the current study's key variables were found on global and emotion-specific recognition accuracy scores. For example, happiness was the most accurately recognised of the six target emotions, consistent with the vast majority of the previous investigations (Gosselin, Kirouac & Doré, 1995). Despite this, the perception of happy emotions was the most affected by the psychological constructs assessed, with underlying alexithymic traits emerging as the only significant predictor of increased happy AFR score in the study's regression analysis. It therefore appears that alexithymia, while having a significant influence on emotional *processing*, may not impact on overall emotion *recognition*, supporting the notion posited by Grynberg and colleagues (2012). As such, it is possible that emotion *recognition* difficulties are only observed in those with clinically significant psychopathological symptoms and detectable in more traditional emotional expression labelling tasks. Therefore, the novel findings from the current study strengthen the applicability of the EEMT, particularly within individuals from the general population with elevated alexithymic traits. By administering more cognitively demanding emotion recognition paradigms to otherwise healthy individuals, subtle emotion processing deficits may be detected.

3.4.4. *Strengths*

The study has numerous strengths. The current study is the first to identify a significant association between alexithymia and decreased sensitivity towards positive affect, using the EEMT (Blair et al., 2001). Furthermore, the study is the first to identify a unique role of the TAS-20 subfactor DIF in this association, even when controlling for co-occurring

depressive/anxiety symptoms and participant demographics. There has been growing speculation that underlying alexithymic traits, at least in part, explains the behavioural deficits classically associated with other symptoms of psychopathology. For example, co-morbid alexithymia has been found to explain emotion recognition (Cook et al., 2013) and empathic behaviour (Bird et al., 2010) deficits in ASC populations. Here, the current study found the cognitive biases most classically associated with depressive symptoms are explained significantly by the alexithymia construct, DIF. Furthermore, as the study identified a significant association between alexithymia and decreased happiness sensitivity in a sample from the general public, it appears this cognitive bias is not limited to individuals with clinically relevant psychopathology. Lastly, the current study employed a relatively large sample size compared to previous studies (e.g., n = 40, Starita et al., 2018; n = 45, Ridout et al., 2010).

3.4.5. *Limitations*

The study is not without limitations. First, a large proportion of the study's sample consisted of female participants. Females have been found to perform better than males in previous emotion recognition paradigms, both in emotional expression-labelling and morphing paradigms (Montagne, Kessels, Frigerio, de Haan & Perrett, 2005). As such, the current study found females to be globally more accurate in detecting and more sensitive towards the emotional expressions presented, with the significance driven predominantly by disgusted faces. Despite this, no significant gender effects were found on happiness response frame scores. Furthermore, participant gender was not found to be associated with any of the psychological constructs assessed. Nevertheless, gender was controlled for in both the study's general linear models and regression analysis in order to remove any extraneous variance in task performance.

Secondly, there may be limitations with the use of the EEMT. The task itself is not a forced-response paradigm; rather, participants can input their answer freely at any point during the emotional expression morphs. Considering this, morphing paradigms are unable to control for individual differences in the perception and processing of the emotional expressions (Joormann & Gotlib, 2006). For instance, high alexithymia scorers may require the same emotional intensities as the low alexithymia scorers to recognise the onset of an emotion, but require further morph increments before they are confident with their identification. If this was the case, alexithymic individuals would have had significantly higher FRA scores compared to the non-alexithymic individuals. However, the current study found no significant effect of alexithymia on either of the accuracy scores. As such, it appears the group differences may not be an artefact of individual differences in emotional processing.

Thirdly, a small proportion of the study's sample were taking psychotropic medication at the time of study involvement. Currently, the literature is heterogeneous regarding the effect of SSRI (selective serotonin reuptake inhibitor)/SNRIs on emotion recognition. For example, the administration of antidepressants has been found to significantly decrease the recognition of fearful (Bhagwagar, Cowen, Goodwin & Harmer, 2004), angry and disgusted faces (Kamboj & Curran, 2006) in MDD patients. Additionally, in a neuroimaging study conducted by Fu and colleagues (Fu et al., 2008), administration of fluoxetine was found to significantly increase brain activity in MDD patients when presented with happy facial expressions compared to those treated with a placebo. In contrast, other authors have identified no significant effect of both antidepressant usage (Rich et al., 2008; Hassel et al., 2008) and cognitive behavioural therapy (Porter et al., 2016) on emotion recognition abilities in individuals with MDD. Despite this, the current study identified no significant group differences between medicated versus non-medicated participants in task

performance, other than in disgust sensitivity. Furthermore, psychiatric illness status and use of psychotropic medication was inserted into the study's regression model as a covariate, with a non-significant effect on happy response frame score being identified.

Fourthly, as the participants' attention was not assessed, any attentional biases could not be controlled for in the study's analyses. In previous investigations, researchers have been within the same testing room as the participants during the experimental procedure. However, we opted to allow the participants privacy in a quiet room while they completed both the psychometric measures and the EEMT. While this may have allowed participants to provide more honest responses in the pre-experiment questionnaire, the researchers could not intervene if the participant was visibly bored or unmotivated to finish the task. Despite this, it would have been clear on inspection of the raw EEMT data if participants were not focused during the experiment as only "final answer" inputs would have been recorded. None of the participants were found to have this response style.

Lastly, the EEMT was administered to investigate behavioural correlates of alexithymic traits in the general population. As such, the utility of the EEMT as a proxy, objective measure of alexithymia remains uncertain as the task would need to be administered in a range of different diagnostic and neurotypical groups.

3.4.6. *Conclusion*

Much of the previous literature exploring the effects of psychopathological symptoms on emotional processing has failed to assess alexithymia concurrently in the tested samples. The current study is the first to identify a significant role of the TAS-20 subfactor, DIF, on the decreased sensitivity towards positive affect. This finding remained intact, even when controlling for potentially co-occurring depressive and anxiety symptoms. As such, these results add to the notion that a reappraisal of the known associations between a number of

psychopathological traits and behavioural correlates should be re-examined with underlying alexithymia taken into account (Cook et al., 2013; Bird et al., 2010; Bird et al., 2011).

Chapter 4

Empirical Study 3:

THE UNIQUE CONTRIBUTIONS OF THE TAS-20 SUBFACTORS ON THE KNOWN CORRELATES OF THE GLOBAL ALEXITHYMIA CONSTRUCT AND THEIR DISTINCTIVENESS FROM DEPRESSIVE AND ANXIETY SYMPTOMS

4.1. Introduction

So far in this thesis, a key aim has been to identify if any of TAS-20 subfactor(s) significantly influence the relationships between subclinical affective symptoms and their known correlates, such as a history of childhood adversity and biases in processing emotional stimuli. In Chapter 2, DIF was found to have a significant mediating role in the relationship between childhood traumatic experiences and depressive/anxiety symptoms developed later in life. Similarly, a regression analysis in Chapter 3 revealed an exclusive role of DIF in the negative cognitive biases towards positive affect using the EEMT (Blair et al., 2001). DDF and EOT however did not emerge as significant predictors. From these results, it can be speculated the DIF subfactor may constitute 'core' alexithymia, supporting the notion put forward by Murphy and colleagues (2017). There has been some recent investigations supporting this speculation. For example, DIF has been found to be the TAS-20 subfactor most significantly associated with PTSD (O'Brien et al., 2008), MDD (Conrad et al., 2009) and GAD (Karukivi et al., 2014) symptom severity in clinical populations. In contrast, EOT has been found to be the TAS-20 subfactor most inversely associated with empathic behaviour (Jonason & Krause, 2013) and theory of mind (Demers & Koven, 2015), known to

be deficit even in the broader autism phenotype (BAP) (Lamport & Turner, 2014; Aykan & Nalçacı, 2018). Despite these promising findings, it remains unknown if similar results emerge in a sample from the general population. Furthermore, no previous research has administered a wide range of measures assessing both psychopathological symptoms and psychosocial deficits to the same nonclinical sample.

As previously described in Chapter 1 Section 1.4, the possible overlap of alexithymic traits with depressive and anxiety symptoms remains contested. While some studies conducted in psychiatric (Loas et al., 2015) and healthy (Lipsanen et al., 2004) populations have concluded that alexithymia is distinct from depression and anxiety, others have found a significant overlap of the psychological constructs (Torres et al., 2015; Hintikka et al., 2001). Additionally, within a sample of psychiatric in-patients, Marchesi, Ossola, Tonna and Panfillis (2014) suggested alexithymic trait severity is directly influenced by the degree of affective and substance abuse disorder symptoms. The authors concluded the TAS-20 may not measure alexithymia *per se*, rather, it is more likely to measure experiences of negative affect (Marchesi et al., 2014). Considering the inconsistency of the previous findings, further research is required to assess if alexithymia exists as a separate psychological construct from other symptoms of psychopathology.

Furthermore, the majority of the previous authors only used the total TAS-20 score in their analyses (Müller et al., 2003; Lipsanen et al., 2004; Parker et al., 1991; Ready et al., 2016). As such, it is unclear if significant overlaps between alexithymia, depressive and anxiety symptoms are observable when the TAS-20 scores are parsed into its proposed subfactors. So far in this body of research, the TAS-20 subfactor DIF has emerged as the alexithymia construct most closely associated with other symptoms of psychopathology. In the previous empirical chapters, DIF was found to share highly significant correlations with both the Becks Depression Inventory ($r = .661$) and the depression subfactor of the Hospital

Depression and Anxiety Scale (r = .543). These correlations were higher than previously found in Li and colleagues' (2015) meta-analysis (r = .400). Additionally, DIF was found to be highly intercorrelated with both the anxiety subfactor of the Hospital Depression and Anxiety Scale (r = .574) and the State Trait Anxiety Inventory – Trait subfactor (r = .669).

4.1.1. *The Current Study*

On identifying the gaps in the current literature, there are three central aims to this empirical chapter. Firstly, to identify if there are the unique contribution(s) of the three TAS-20 subfactors, DIF, DDF and EOT, on some of the established correlates of global alexithymia. This will be done by administering measures of psychopathological symptoms (i.e., depression, anxiety and PTSD), childhood adversity and psychosocial deficits (i.e, empathic behaviour and autistic traits). Secondly, to establish if these associations are independent of other symptoms of negative affect, correlations will be rerun correcting for co-occurring depressive/anxiety symptoms. Finally, the chapter aims to investigate if DIF is a distinct psychological construct.

4.2. Methods

4.2.1. *Participants*

Participants were a subset of the sample analysed in Chapter 2 who completed additional measures on the second wave of online Qualtrics questionnaire dissemination (see Appendix 3 Section A3.1). A total of 231 participants took part, with 46 males (19.90%) and an age range of 18 to 72 (mean = 30.24, SD = 13.57). Educational attainment ranged from 79 with school qualifications (34.20%), 97 with an undergraduate degree (42%), 51 with a postgraduate degree (22.10%) and 4 with a doctorate degree (1.70%).

4.2.2. *Measures*

As the participants analysed in this chapter were a subset of the sample recruited in Chapter 2, a full overview of the HADS, TAS-20 and CTQ can be found within that chapter.

4.2.2.1. Toronto Alexithymia Scale-20 (TAS-20)

A full overview of the TAS-20 (Bagby et al., 1994) can be seen in Chapter 2. As the previous findings from this body of work found no significant contributions of both the DDF and EOT subfactors, they were collapsed into a composite "DDF/EOT" score. This was done to identify unique contributions of the DIF from the other two TAS-20 subfactors.

4.2.2.2. Autism-Spectrum Quotient (AQ)

The AQ (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a widely used measure to assess autistic traits, consisting of 50 items (e.g., "I notice patterns in things all the time"). The AQ has high internal consistency (α <.900; Baron-Cohen et al., 2001) and is considered a sensitive measure for detecting autistic traits even within the general population (Ruzich et al., 2015). Participants are asked to rate the items on a 4-point Likert scale, from 1 = "Definitely Disagree" to 4 = "Definitely Agree". Responses to each item are scored as 1 if an autistic trait is endorsed, and 0 if no autistic trait is endorsed. Scores range from 0 to 50, with higher scores indicative of more autistic traits. Furthermore, a threshold score of 26 on the AQ has been established to have an adequate sensitivity (.950) and specificity (.520) to detect clinically significant autistic traits (Woodbury-Smith, Robinson, Wheelwright & Baron-Cohen, 2005).

4.2.2.3. Empathy Quotient – Short Form (EQ-SF)

The EQ-SF (Wakabayashi et al., 2006) is a 22-item measure that assesses trait empathy in adults. It is a shorthand version of the full EQ developed by Baron-Cohen and

Wheelwright (2004) and has been found to have good internal consistency (α <.800; Wakabayashi et al., 2006). Participants are asked to rate statements (e.g., "I really enjoy caring for people") on a 4-point Likert scale from 1 = "Strongly Disagree" to 4 = "Strongly Agree". Completion of the EQ-SF took approximately eight minutes. Items that are rated with a strong empathic response are scored as 2 points, 1 point for a slightly empathic response and 0 points if the response is not empathic. Scores range from 0 to 44, with higher scores indicative of more empathic behaviour towards others.

4.2.2.4. Post-Traumatic Stress Disorder Checklist: Civilian Version (PCL-C)

The PCL-C (Weathers, Litz, Herman, Huska & Keane, 1993) is a 17-item measure that assesses each DSM-IV criterion for post-traumatic stress disorder. The measure has been shown to have good validity (α <.900; Blanchard, Jones-Alexander, Buckley & Forneris, 1996) and has been utilised in both clinical (van der Velden & Wittmann, 2008) and non-clinical (Frans, Rimmö, Åberg & Fredrikson, 2005) adult populations. Participants are asked to rate their agreement towards statements on the experience of stressful life events (e.g., "feeling very upset when something reminded you of a stressful experience from the past") on a 5-point Likert scale (1 = "Not at All" to 5 = "Extremely"). Participants rated the statements about the symptoms they had experienced over the past four weeks. Completion of the PCL-C took approximately six minutes. Scores range from 17 to 85, with higher scores indicative of more severe PTSD symptoms. While agreement has yet to be met regarding a cut-off score for the civilian version of the PCL-C, previous investigations have used scores above 44 to indicate elevated PTSD symptoms (Blanchard et al., 1996). Using this recommended cut-off has been found to yield a good diagnostic efficiency of .900, with high sensitivity (.944) and specificity (.864) (Blanchard et al., 1996).

4.2.3. *Procedure*

A detailed description of the study's procedure can be found in Chapter 2. Links to the online questionnaire were disseminated via social media networks and through the Psychology Department's participant recruitment database. Participants were asked to provide informed consent prior to the commencement of the questionnaire and they were informed their participation was anonymous and voluntary. After completing the psychometric measures, participants were then asked to provide demographic information. Participation in the full questionnaire took approximately 45 minutes. On completion of the questionnaire, participants were debriefed on the experimental aims. Ethical approval was obtained by the Edinburgh University Research Ethics Committee (29-1718/4).

4.2.4. *Statistical Analysis*

After cleaning the data and identifying multivariate outliers, the distributions of the key variable scores were explored. In order to identify any significant relationships between DIF and the key assessment measures, correlational analyses were run. Furthermore, in order to identify significant differences between the correlations, the TAS-20 subfactors DDF and EOT were merged and additional correlational analyses were conducted. Any gender effects on DIF or DDF/EOT scores were assessed with t-tests bootstrapped with 5000 iterations as a large bias towards female participants was found in the study's sample. A multivariate step-wise linear regression was then run in order to identify which variable(s) explained significant variance in DIF and DDF/EOT composite scores. To assess autocorrelation in the regression model's residuals, a Durbin Watson statistic between 1.50 and 2.50 and VIFs under 10 for each variable in the regression models were considered acceptable (Ahsan, Abdullah, Fie & Alam, 2009). As depressive symptoms emerged as the most significant predictor of DIF, partial correlation analyses were run in order to investigate if the

subfactor's significant correlations with the other tested variables survived after having corrected for depressive and anxiety symptoms. Lastly, exploratory factor analyses were conducted in order to ascertain if DIF, HADS – D and HADS-A items emerge as separate constructs. A KMO measure of sampling adequacy above .600 and a significant Bartlett's test of sphericity were considered acceptable (Frohlich & Westbrook, 2001). Data was analysed on SPSS version 22 (IBM Corporation, Armonk, NY, USA).

4.3. Results

4.3.1. *Data Cleaning*

In addition to the data cleaning procedure discussed in Chapter 2, additional cleaning was required on the AQ, EQ-SF and PCL-C data. A total of 301 participants consented to take part in the online questionnaire. Forty five participants exited the questionnaire during participation, and were therefore removed from the dataset. On inspection of the complete questionnaire responses, missing data was addressed using an *a priori* rule in which individuals with >4 missing data points in any of the measures were excluded from analysis. Using this rule, an additional 19 participants were identified and removed from the dataset. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. Lastly, in order to identify multivariate outliers, Mahalanobis' distances were calculated with the critical alpha set at $p < .001$. With the critical chi-square of 22.46, six participants identified as outliers and were therefore excluded from the dataset. This gave a final sample size of 231 participants.

4.3.2. *Descriptive Statistics*

4.3.2.1. Distributions of scores

The means, standard deviations and score distributions are shown in Table 4.1. On inspection of the score distributions, 39 participants (16%) were above the cut-off recommended to detect marked PTSD symptoms using the PCL-C. Furthermore, 25 (9.5%) participants were found to have significantly elevated AQ scores, scoring over the threshold score of 26. For TAS-20 scores, 23 (10%) participants were above the cut-off of 61. Using the cut-offs established for the HADS subscales, a total of 17 (7.3%) and 37 (16.2%) participants were found to have moderate/severe depressive and anxiety symptoms, respectively. Lastly, the most prevalent form of trauma experienced was emotional neglect, with 24 (10.4%) participants experiencing moderate or severe emotional neglect during their childhood. The least prevalent was sexual abuse, with 10 (4.4%) participants rating moderate and severe experiences of the traumata.

4.3.3. *Correlational Analyses*

In order to establish significant relationships between DIF and the key assessment scores, correlational analyses were run. Furthermore, to establish if DIF was significantly more correlated than the two other TAS-20 subfactors, DDF and EOT, these additional subfactors were parsed together and Fisher's r-to-z transformations were conducted. Results are shown in Table 4.2. On inspection of the Fisher's r-to-z scores, DIF correlated significantly more with the psychopathological symptoms; depressive symptoms ($Z_{observed}$ = 3.22, p = .001), anxiety ($Z_{observed}$ = 4.760, p <.001) and PTSD symptoms ($Z_{observed}$ = 3.45, p < .001). Furthermore, DIF scores were more significantly associated with the experience of emotional abuse ($Z_{observed}$ = 2.82, p = .004) and emotional neglect ($Z_{observed}$ = 2.09, p = .036) compared to the DDF/EOT composite score. While no significant difference between the

Table 4.1.

Means, standard deviations and ranges for key variables and their subfactors.

Measure	Mean	SD	Range	% of subjects above cut-off		
				Low	Moderate	Severe
TAS-20	48.06	9.60	20 – 74	n.a	22.9	10
DIF	16.91	5.25	7 – 28			
DDF	12.56	3.65	5 – 23			
EOT	18.67	3.80	8 – 30			
HADS	13.24	6.36	0 – 30			
HADS-Depression	4.10	2.95	0 – 19	12.1	5.8	1.3
HADS-Anxiety	9.05	3.96	0 – 21	20.0	10.2	6.0
CTQ	34.33	8.99	25 – 63			
CTQ- Emotional Abuse	8.53	3.87	5 – 24	17.6	4.2	4.8
CTQ-Emotional Neglect	8.74	3.84	5 – 22	18.7	7.4	3.0
CTQ-Physical Abuse	5.88	1.67	5 – 16	9.9	3.6	1.5
CTQ-Physical Neglect	5.81	1.49	5 – 12	4.7	5.6	1.2
CTQ-Sexual Abuse	5.42	1.59	5 – 15	2.0	3.1	1.3
EQ-SF	24.72	8.26	2 – 44			
AQ	17.42	6.67	1 – 47			9.5
PTSD-CL	32.12	12.12	17 – 78			16

Note. DIF: Difficulty Identifying Feelings, HADS: Hospital Depression Anxiety Scale, AQ: Autism-Spectrum Quotient, EQ-SF: Empathy Quotient-Short Form, CTQ: Childhood Trauma Questionnaire, PTSD-CL: Post-Traumatic Stress Disorder-Checklist, n.a: not applicable.

correlations on AQ score was identified ($Z_{observed}$ = .560, p = .575) the DDF/EOT composite score was significantly more associated with empathy ($Z_{observed}$ = -3.36, p <.001).

4.3.4. *Identifying Confounding Variables*

In order to identify any confounding variables for the later analyses, the effects of participant age, gender and educational attainment were assessed. First, no significant correlation was identified between participant age and DIF (r = -.054, p = .415) or DDF/EOT

(r = -.50, p = .454) scores. Secondly, independent sample t-tests bootstrapped with 5000 interactions identified no significant gender effect on either DIF (t(228) = -.372, p = .683) or DDF/EOT (t(228) = .473, p = .587) scores. Lastly, an ANOVA revealed a non-significant main effect of educational attainment on both DIF (F(3, 230) = 2.44, p = .065) or DDF/EOT score (F(3, 227) = 2.08, p = .104).

Table 4.2.

Correlational analyses between DIF and DDF/EOT, with Fishers r-to-z transformations

Measure	DIF	DDF/ EOT	Z score
CTQ	.308***	.084	2.50**
CTQ- Emotional Abuse	.283***	.027	2.82**
CTQ-Emotional Neglect	.356***	.175**	2.09*
CTQ-Physical Abuse	.109	-.010	n.s
CTQ-Physical Neglect	.178**	.063	n.s
CTQ-Sexual Abuse	.052	.087	n.s
HADS	.614***	.264***	4.75***
HADS-Depression	.532***	.283***	3.22**
HADS-Anxiety	.544***	.163*	4.76***
AQ	.398***	.353***	n.s
EQ-SF	-.171**	-.452***	-3.36***
PTSD-CL	.533***	.265***	3.45***

Note. DIF: Difficulty Identifying Feelings, HADS: Hospital Depression Anxiety Scale, AQ: Autism-Spectrum Quotient, EQ-SF: Empathy Quotient-Short Form, CTQ: Childhood Trauma Questionnaire, PTSD-CL: Post-Traumatic Stress Disorder-Checklist. *p<.05, **p<.01, ***p<.001, n.s = non-significant.

4.3.5. *Regression Analyses*

In order to identify the significant predictor(s) of DIF scores, all the key variables which shared a significant correlation with DIF were entered into a multivariate step-wise linear regression. As no significant effect of participant demographics were identified, no confounding variables were required to be entered into the model. Results are shown in Table

4.3. Depressive symptoms emerged as the main predictor of DIF score, explaining 29.30% of the variance (β = .542, p <.001). A further 11.40% of the variance was explained by anxiety (β = .351, p <.001), 2.10% by PTSD symptoms (β = .202, p = .004) and 1.20% by autistic traits (β = .123, p = .036). As the variables did not explain a significant proportion of the variance, the CTQ subfactors emotional abuse (β = .071, p = .195), emotional neglect (β = .091, p = .097) and physical neglect (β = .017, p = .755) were excluded from the regression model. Furthermore, empathic behaviour did not emerge as a significant predictor (β = .048, p = .423). The Durbin Watson statistic of 1.99 suggested little autocorrelation between the residuals (see Appendix 3 Section A3.2 for regression plots).

Table 4.3.

Multivariate linear regression analyses with DIF as the dependant variable.

Step	Predictor Variables	β	t	VIF	R^2	ΔR^2	*F*
1	HADS-D	.542	9.95^{***}	1.00	.293	.293	53.85^{***}
2	HADS-D	.346	5.93^{***}	1.40	.407	.114	52.40^{***}
	HADS-A	.351	5.83^{***}	1.40			
3	HADS-D	.293	4.64^{***}	1.59	.428	.021	42.62^{***}
	HADS-A	.256	3.78^{***}	1.83			
	PTSD-CL	.202	2.88^{**}	1.96			
4	HADS-D	.261	4.07^{***}	1.67	.440	.012	35.61^{***}
	HADS-A	.245	3.66^{***}	1.84			
	PTSD-CL	.169	2.38^{*}	2.05			
	AQ	.126	2.18^{*}	1.35			

Note. HADS-D: Hospital Depression and Anxiety Scale: Depression Subfactor, HADS-A: Hospital Depression and Anxiety Scale: Anxiety Subfactor, PTSD-CL: Post-Traumatic Stress Disorder - Checklist, AQ: Autism-Spectrum Quotient, VIF: Variance Inflation Factor. *p <.05, **p <.01, ***p <.001

A second multivariate stepwise linear-regression was performed with DDF/EOT scores as the dependant variable in order to assess which of the assessment measure(s)

explained a significant proportion of their variance. Results are shown in Table 4.4. Empathic behaviour emerged as the largest predictor, explaining 20.40% of the variance (β = -.452, p <.001). An additional 4.70% of the variance was explained by depressive symptoms (β = .220, p <.001). Autistic traits (β = .108, p = .121), anxiety symptoms (β = .039, p = .573), PTSD symptoms (β = .125, p = .072) and emotional neglect (β = .079, p = .198) were all excluded as they did not contribute significantly to the regression model. A Durbin Watson statistic of 2.08 suggested little autocorrelation between the residuals (see Appendix 3 Section A3.2 for regression plots).

Table 4.4.

Multivariate linear regression analyses with DDF/EOT as the dependant variable.

Step	Predictor Variables	β	t	VIF	R^2	ΔR^2	*F*
1	EQ-SF	-.452	-7.67***	1.00	.204	.204	58.81***
2	EQ-SF	-.419	-7.23***	1.02	.252	.047	38.37***
	HADS-D	.220	3.80***	1.02			

Note. EQ-SF: Empathy Quotient-Short Form, HADS-D: Hospital Anxiety and Depression Scale – Depression subfactor, VIF: variance inflation factor. ***p <.001.

4.3.5. *Partial Correlational Analyses*

After establishing depressive and anxiety symptoms to be the main predictors of DIF score, it was of interest to investigate if DIF's relationships with the other assessed variables remained significant when controlling for these possible confounders. The partial correlation analyses revealed the relationships between DIF and autistic traits (r = .191, p = .009), PTSD (r = .189, p = .004), empathic behaviour (r = -.131, p = .048) and total childhood adversity scores (r = .196, p = .003) survived controlling for depressive and anxiety symptoms. At the CTQ subfactor level, DIF and emotional neglect (r = .186, p = .005) also remained

significant. However, the relationships between emotional abuse, physical neglect and DIF became non-significant once depressive and anxiety symptoms were corrected for (r = .112, p = .090; r = .048, p = .467, respectively).

It was also of interest to assess if the correlations between the DDF/EOT composite score and the assessment measures survived after controlling for DIF scores. The partial correlation analyses revealed the relationships between DDF/EOT and PTSD (r = .052, p = .432), anxiety (r = .184, p = .184), depressive symptoms (r = .076, p = .249) total childhood adversity scores (r = -.043, p = .522) became non-significant once DIF scores were corrected for.

At the CTQ subfactor level, emotional neglect (r = .043, p = .514) and DDF/EOT scores became non-significant. However, the relationships between DDF/EOT and autistic traits (r = .222, p = .001) and empathic behaviour (r = -.425, p <.001) remained intact after controlling for DIF.

4.3.6. *Factorial Analysis*

As depressive and anxiety symptoms predicted a large proportion of the variance in DIF score, two exploratory factor analyses were lastly conducted in order to assess DIF's distinctiveness from symptoms of negative affect. First, the factor loadings of the items from the DIF and HADS-Depression subfactor were assessed. Results are shown in Table 4.5. The KMO test of sampling adequacy was .878, suggesting the data had a high factorability. Furthermore, the Bartlett's test of sphericity was significant (χ^2 (91) = 1086.86, p <.001). As it was expected the factors would correlate significantly, an oblimin rotation was selected for the analysis. Factor loadings under .300 were suppressed in the factor model. Three factors emerged, with the first factor (F1) producing an Eigen value of 5.16 and explaining 36.82% of the variance. The second factor (F2) produced an Eigen value of 1.67,

Table 4.5.

Exploratory factor analysis on DIF and HADS – Depression items: principal component analysis with an oblimin rotation.

Measure		Item	F1: Difficulty identifying emotions	F2: Depressive Symptoms	F3: Difficulty identifying sensations
DIF	1.	I am often confused about what emotion I am feeling.	.848		
	14.	I often don't know why I am angry.	.759		
	6.	When I am upset, I don't know if I am sad, frightened or angry.	.735		
	9.	I have feelings that I can't quite identify.	.664		
	13.	I don't know what's going on inside me.	.559		
	9.	I have physical sensations that even doctors don't understand.			.804
	7.	I am often puzzled by sensations in my body.			.768
HADS -D	12.	I look forward with enjoyment to things.		.846	
	2.	I still enjoy the things I used to enjoy.		.802	
	4.	I can laugh and see the funny side of things.		.735	
	6.	I feel cheerful.		.686	
	14.	I can enjoy a good book or radio or TV programme.		.508	
	8.	I feel as if I am slowed down.		.495	
	10.	I've lost interest in my appearance.		/	

Note. DIF: Difficulty Identifying Feelings, HADS-D: Hospital Anxiety and Depression Scale – Depression subfactor, /: factor loading below .3.

explaining 11.90% of the variance and the last factor (F3) produced an Eigen value of 1.02, explaining 7.36% of the variance. Interestingly, the DIF subfactor fell into two distinct factors; “difficulty identifying emotions” (F1) and “difficulty identifying sensations” (F3). The two DIF factors correlated at r = .423, with F1 correlating with the depressive symptom factor at r = .349 and F3 correlating with the depressive symptom factor at r = .271. Results from the factor analysis suggest while DIF and depressive symptoms are highly intercorrelated, both exist as separate domains.

The analysis was then rerun using items from the HADS-Anxiety subfactor (see Table 5.6). Similar KMO statistics (.886) and Bartlett’s test of sphericity (χ^2 (91) = 1195.70, p <.001) emerged, suggesting the data had high factorability. Similar to the previous analysis, three factors emerged. F1, or “difficulty identifying emotions” had an Eigen value of 5.44, explaining 38.85% of the variance. F2, or “anxiety symptoms” explained 11.88% of the variance, with an Eigen value of 1.66. Lastly, F3, or “difficulty identifying sensations” produced an Eigen value of 1.02, explaining 7.31% of the variance in the factor model. On inspection of the component correlation matrix, the factor F1 produced a correlation with F2 of r = .380 and with F3 at r = .420. Lastly, F2 and F3 correlated at r = .318. While the majority of the DIF and HADS-A items remained separate, it was discovered the item “I feel restless; as if I have to be on the move” from the HADS-A subfactor loaded significantly positively onto the “difficulties in identifying sensations” factor.

4.4. Discussion

A prevailing finding has emerged across this body of research. The TAS-20 subfactor DIF has been shown to contribute to known correlates of depressive and anxiety symptoms, namely experiences of childhood adversity and maladaptive emotional facial expression processing. However, the contributions of the other TAS-20 subfactors, DDF and EOT were

Table 4.6.

Exploratory factor analysis on DIF and HADS – Anxiety items: principal component analysis with an oblimin rotation.

Measure		Item	F1: Difficulty identifying emotions	F2: Anxiety symptoms	F3: Difficulty identifying sensations
DIF	1.	I am often confused about what emotion I am feeling.	.794		
	14.	I often don't know why I am angry.	.788		
	6.	When I am upset, I don't know if I am sad, frightened or angry.	.766		
	9.	I have feelings that I can't quite identify.	.688		
	13.	I don't know what's going on inside me.	.614		
HADS -A	3.	I have physical sensations that even doctors don't understand.			.740
	7.	I am often puzzled by sensations in my body.			.670
	11.	I feel restless; as if I have to be on the move.		.344	.514
	5.	Worrying thoughts go through my mind.		.846	
	13.	I get sudden feelings of panic.		.808	
	3.	I get a sort of frightened feeling as if something awful is about to happen.		.807	
	9.	I get a sort of frightened feeling, like "butterflies" in the stomach.		.665	
	7.	I can sit at ease and feel relaxed.		.599	
	1.	I feel tense or "wound-up".		.557	

Note. DIF: Difficulty Identifying Feelings, HADS-A: Hospital Anxiety and Depression Scale – Anxiety subfactor.

negligible. While these findings are promising, it remains unclear if DIF exists as a separate psychological construct, distinct from depressive and anxiety symptoms. Therefore, the key aim of this empirical chapter was to assess DIF's distinctiveness from the other components of global alexithymia and negative mood states.

The first finding from the chapter was the unique association between the DIF subfactor and depressive, anxiety and PTSD symptoms in a sample of adults from the general population. Interestingly, this is in support of Grabe and colleagues' (2004) findings in a sample of psychiatric in- and outpatients, in which DIF scores were found to be an exclusive predictor of clinically significant psychopathological symptoms (Grabe et al., 2004). DIF scores were also more closely associated with a history of psychological trauma during childhood.

It may be speculated the experiences of psychological abuse and neglect from caregiver(s) illicit disturbances in a child's emotional awareness, in turn making them more at risk for later-life alexithymic traits (Montebarocci et al., 2004). As such, DIF scores have been recently found to partially mediate the path between PTSD from past childhood trauma to later-life psychiatric comorbidity (Chung & Chen, 2017). In the current study, partial correlation analyses revealed DIF's correlations between emotional abuse and physical neglect became nonsignificant on correcting for depressive and anxiety symptoms. This is in accordance with the findings of Chapter 2, in which the associations between these trauma and depressive/anxiety symptoms were the most resilient to DIF's mediation. Conversely, DIF's correlation with emotional neglect survived after controlling for depressive and anxiety symptoms. It therefore appears difficulties in recognising one's feelings may be more likely to develop when exposed to emotional neglect during childhood, in turn predisposing individuals to later-life psychiatric illness. This is in direct support of the notion put forward

in Chapter 2 in which DIF may be a proxy-measure for interoceptive awareness, speculated to be the underlying 'psychopathology-', or 'p-factor' (see Chapter 2 for full overview).

Partial correlations, after correcting for DIF, also confirmed no significant associations between the DDF/EOT composite score and symptoms of negative affect. Instead, the composite score was more closely associated with a lack of empathic behaviour, as the correlation between DDF/EOT and EQ-SF remained significant after controlling for DIF. As such, empathy emerged as the largest predictor of DDF/EOT, predicting 20.7% of the variance. While the majority of the previous studies have identified a unique contribution of the EOT subfactor and blunted empathic behaviour, a minority of studies have found a similar trend with DDF scores. In a study conducted by Grynberg and colleagues (2010), EOT and DDF were found to significantly predict decreased empathic concern and perspective taking in a sample of university students, whereas the contribution of DIF was negligible. It may be speculated individuals who experience difficulties in articulating their feelings may in turn avoid emotionally salient discourse, blunting their empathic behaviour towards others.

Interestingly, no significant differences in the correlations between the two alexithymia subfactors and AQ scores were identified. Autistic traits are classically associated with empathic difficulties (e.g., diminished theory of mind) both in clinical (Baron-Cohen, 1997) and neurotypical (Craig, Grossman & Krichmar, 2017) populations. As such, the DDF/EOT composite score's association with autistic traits may have been explained by the empathic behaviour component of the AQ. However, a significant association has also been found between autistic traits and an increased prevalence of co-morbid psychopathological symptoms (e.g., depression and anxiety) in both clinical (Howlin, 2000) and neurotypical (Culpin et al., 2018) populations. It is possible this association was underpinned by the DIF score. Taken together, it therefore appears the cognitive and affective manifestations of

autistic traits in the general population significantly correlate with both the DIF and DDF/EOT composite scores.

As discussed earlier in the chapter, there remains some disagreement regarding the distinctiveness of alexithymic traits from other symptoms of psychopathology, notably depression and anxiety. Within this empirical chapter, a large proportion of the variance in DIF scores was explained by depressive (29.70%) and anxiety (11.70%) symptoms. Considering this, it was lastly of interest to ascertain if DIF was a distinct psychological construct. Results from the factor analysis revealed a full separation of DIF from depressive symptoms, supporting the notion the two psychological constructs do not overlap, even within non-clinical subjects (Honkalampi, Hintikka, Laukkanen & Viinamäki, 2001). Interestingly, the DIF parsed into two 'mini' components; difficulties identifying emotions and difficulties identifying sensations. From a theoretical perspective, alexithymic individuals have been posited to misidentify sensations felt during emotional experiences as physical illnesses (Taylor et al., 1999). As such, psychosomatic complaints and alexithymic traits have been found to be closely associated (Lundh & Simonsson-Sarnecki, 2001). While depressive symptoms and DIF emerged as separate constructs, a slight overlap emerged between DIF and anxiety symptoms. Specifically, the item "I feel restless; as if I have to be on the move" from the HADS' anxiety subfactor cross-loaded onto the "difficulty identifying sensations" factor. Anxiety disorders are characterised by unpleasant physical sensations when experiencing acute psychological stress such as nausea, tremors and tachycardia (Lader, 2015). Therefore, the overlap may be in part due to the similar predisposition to experience psychosomatic complaints. Despite this, the majority of the HADS-Anxiety items loaded separately from DIF items suggesting the two psychological constructs are predominantly distinct from one another.

4.4.1. *Limitations*

As the current study used data collected from a subset of the participants analysed in Chapter 2 and utilised the same data collection technique, the methodological limitations are similar. First, there was a large skew towards female participants in the sample. Despite this, no significant effect of participant gender was identified on any of the TAS-20 subfactor scores, as found in Chapters 2 and 3. While some have speculated men are significantly more alexithymic than women (Salminen, Saarijärvi, Äärelä, Toikka & Kauhanen, 1999), no significant gender effects have been found in other previous investigations (Karukivi et al., 2014). Furthermore, in a meta-analysis of 44 studies, Levan and colleagues (2009) found the gender difference in TAS-20 scores negligible, with a small effect size of d = .220 (Levant, Hall, Williams & Hasan, 2009). As such, it appears gender does not significantly influence alexithymic trait severity. Secondly, while the anonymous online questionnaire may have facilitated individuals to provide more accurate reports of their symptomology and childhood adversity, it was not possible to confirm if the participants completed the study with their full attention. Lastly, the sample size could be considered too small to run exploratory factor analysis. While opinion varies, the subjects-to-variables (STV) ratio required to conduct EFA has been recommended at 20:1 (Kline, 1997). Using this rule, the current chapter required at least 280 participants. While the sample was below the recommended size (n = 231), a more recent stance has suggested an STV as low as 10:1 can provide robust findings in factor analyses (Osborne & Costello, 2004).

4.4.2. *Conclusion*

Taken together, results from the current chapter provided new insight into the uniqueness of the DIF subfactor from the other components of the alexithymia construct. While DIF is more closely associated with a subset of psychopathological symptoms and

previous childhood adversity, DDF and EOT are more significantly associated with diminished empathic behaviour. Furthermore, DIF appears to exist as a distinct psychological entity, separate from subclinical depressive and anxiety symptoms. To the author's knowledge, this is the first attempt to identify the unique contributions of the DIF subfactor on other symptoms of psychopathology in a sample from the general public. From the current chapter's results, it may be speculated DIF is be the most clinically relevant component of the alexithymia construct and may be related to an underlying "p-factor" that can predispose individuals to develop later-life psychopathology. Considering this, potential treatment strategies (e.g., mindfulness-based interventions) may benefit from focusing particularly on an individual's difficulty identifying their feelings (see Chapter 8 for more discussion).

Chapter 5

Empirical Study 4:

THE PSYCHOMETRIC PROPERTIES OF A PARENT-REPORT MEASURE OF ALEXITHYMIA IN CHILDREN: THE ALEXITHYMIA QUESTIONNAIRE FOR CHILDREN – PARENT (AQC-P)

5.1. Introduction

Over the past two decades, there has been an interest in assessing alexithymic behaviours in children and young adolescents. However, much of the previous literature has focused on alexithymia's relationship with developmental disorders, notably ASC (Bird et al., 2010; Bird et al., 2011; Heaton et al., 2012; Cook et al., 2013; Costa et al., 2017). While these studies have yielded promising findings with regards to illuminating alexithymia's comorbidity with psychiatric conditions, the distributions and correlates of alexithymia in typically developing children have been seldom investigated. Perhaps this is due to the notion that children are alexithymic '*by proxy*', as they have yet to develop the cognitive skills to introspect on their emotions (Parker et al., 2010). Therefore, administering measures of alexithymic traits to child populations may produce invalid and unreliable results (Parker et al., 2010). This potential limitation may be circumvented with the administration of a parent-report measure of alexithymia that can be undertaken either independently or concurrently with a self-evaluative measure.

However, as described in Chapter 1 Section 1.7, an overarching limitation of the previous studies has been the paucity of valid and reliable observer-reported measures of

alexithymic traits. Within adult populations, the OAS (Haviland et al., 2000) remains the most commonly administered peer-report measure of alexithymia. However, previous investigations have found weak correlations between the OAS and the self-reported TAS-20 (Lumley et al., 2005; Meganck et al., 2010) and AQC (Davies et al., 2015). These poor associations may be, in part, due to the differing conceptulisations of alexithymia across the measures (see Chapter 1 Section 1.7 for full overview). Within child populations there were only two published parent-rated assessment tools; the JASC-TF (Fukunishi et al., 1998) and the CAM (Way et al., 2010). Past studies have identified numerous methodological limitations of these measures, such as the non-significant relationship between the CAM and the self-rated AQC (Griffin et al., 2016). As the items from the AQC and the CAM were selected from different adult measures, it is possible this finding was due to the lack of similarity and overlap between the two assessment tools. Therefore, it may be speculated a complementary parent-report measure, based on the AQC, may evade measure disagreement and score comparison issues (Griffin et al., 2016). This may have benefits to early-life alexithymia research, as the administration of the same measure to both the child and their parent(s) concurrently may facilitate a more complete representation of the child's alexithymic trait severity.

Recently, this has been achieved with the construction of the AQC-P (Costa et al., 2017). Despite this promising development, the original authors did not assess the psychometric properties of the measure outwith its internal consistency, nor its level of agreement with its self-rated counterpart. Furthermore, to date, the measure has not been used since publication. Considering this, it remains unknown if the AQC-P is a valid, reliable measure of early-life alexithymia.

5.1.2. *The Current Study*

Considering the lack of research in this area, the current empirical chapter has two overarching aims. Firstly, to investigate if the AQC-P is a psychometrically sound parent-report measure of early-life alexithymia in a sample of healthy children. This will be done by assessing the AQC-P's validity, psychometric properties, factor structure and level of agreement with the original self-rated AQC. In addition, the associations between the AQC-P and known correlates of alexithymia in adults (e.g., depressive symptoms, decreased empathic behaviour and maladaptive internal and external behaviours) are not yet understood. Consequently, the second aim of the chapter was to assess the strength of the relationships between both the AQC and AQC-P with these known correlates.

5.2. Method

5.2.1. *Participants*

Recruitment occurred over three waves of questionnaire distribution. Firstly, pupils were recruited from two schools in the UK. In total, 521 families were approached to take part in the study. Of those approached, 175 families volunteered to take part, producing a response rate of 23%. Secondly, 45 families were contacted via a database of volunteers, willing to take part in developmental studies conducted by the University of Edinburgh. Here, 25 families took part, producing a response rate of 55%. Lastly, 57 families took part in a laboratory study which included children and parent(s) completing the measures. The sample consisted of 120 boys and 130 girls between 8 to 13 years (mean age = 10.13; SD = 1.06).

5.2.2. *Materials*

Questionnaires were administered as a child and parent booklet provided to participating families, containing a self-report questionnaire for children and a parent-report questionnaire for the parent(s).

5.2.2.2. Child measures

5.2.2.2.1. *Alexithymia Questionnaire for Children (AQC)*

Alexithymia Questionnaire for Children ('AQC'; Rieffe et al., 2006) is a 20 item scale used to assess alexithymia in children as young as eight. It is built upon the three original subfactors of the TAS-20 (Bagby et al., 1994); DIF, DDF and EOT, where some items are reworded to aid understanding by children. The AQC has been used across several studies and has been found to have good internal consistency ($\alpha > .700$) (Rieffe et al., 2006). Using Rieffe and colleagues' (2006) scoring system, items were rated on a three-point scale (1 = "Not True" to 3 = "True") in order to simplify the response scale for child participants. Completion of the AQC took approximately eight minutes. Scores ranged from 20 to 60, with higher scores indicating a greater degree of alexithymic traits.

5.2.2.2.2. *Depression Self-Rating Scale (DSRS)*

The Depression Self-Rating Scale (DSRS; Birleson, 1981) is an 18 item self-assessment scale that investigates depressive symptoms in children (e.g. "I feel so sad I can hardly stand it", and, "I look forward to things as much as I used to"). It has good internal consistency ($\alpha > .800$) (Ivarsson & Gillberg, 1997) and a cut-off score of 15 has adequate sensitivity (.730) and specificity (.750) at detecting elevated depressive symptoms in children (Fundudis et al., 1991). Completion of the DSRS took approximately four minutes. Items were rated on a 3-point Likert scale, from 0 = "Never" to 2 = "Always". Scores ranged from 0 to 36, with higher scores indicating greater depressive symptoms.

5.2.2.3. Parent measures.

5.2.2.3.1. *Alexithymia Questionnaire for Children – Parent (AQC-P)*

The Alexithymia Questionnaire for Children (Rieffe et al., 2006) was modified for use in parent(s) of young children (Costa et al., 2017). The Alexithymia Questionnaire for Children– Parent or 'AQC-P', retains the same wording used by Rieffe and colleagues' (2006) (e.g., "I am able to describe my feelings easily" became, "my child is able to describe their feelings easily"), with the same three subfactors DIF, DDF and EOT. The measure has been found to have good internal consistency ($\alpha < .800$; Costa et al., 2017). Like the AQC, the AQC-P is rated on a 3-point Likert scale in order to alleviate potential score comparison issues. Completion of the AQC-P took approximately six minutes. Scores ranged from 20 to 60, with higher scores indicating a greater degree of alexithymic traits.

5.2.2.3.2. *Empathy Quotient for Children (EQ-C)*

The Empathy Quotient for Children (EQ-C; Auyeung et al., 2009) is a 27-item parent-report tool used to assess empathic behaviour in children (e.g., "My child has trouble forming friendships" and "My child gets very upset if they see an animal in pain"). The measure has been validated for use by parents in children as young as four and has good internal consistency ($\alpha > .900$, Auyeung et al., 2009). "Definitely Agree" and "Slightly Agree" responses to items endorsing empathic behaviour were scored as 2 and 1, respectively. "Definitely Disagree" and Slightly Disagree" responses were scored as 0. Likewise, "Definitely Agree" and "Slightly Agree" responses to items endorsing non-empathic behaviour were scored as 0. "Definitely Disagree" and "Slightly Disagree" responses were scored as 2 and 1, respectively. Completion of the EQ-C took approximately seven minutes. Scores range from 0 to 54, with higher scores indicative of more empathic behaviour.

5.2.2.3.3. *Strength and Difficulties Questionnaire (SDQ)*

The Strength and Difficulties Questionnaire (SDQ) (Goodman, 1997) is an 25-item behavioural screening tool containing five sub-measures of negative or positive behaviour; 'SDQ-Conduct Problems', SDQ-'Inattention-Hyperactivity', SDQ-'Emotional Symptoms', SDQ-'Peer Problems' and SDQ-'Prosocial Behaviour'. It has been validated for use by parents and teachers of 4 to 16 year old children. The measure has good internal consistency ($\alpha > .700$; Goodman, Ford, Simmons, Gatward & Meltzer, 2000) and has congruent validity with other measures of clinically relevant behavioural difficulties (Goodman et al., 2000). Items were rated on a 3-point Likert Scale, from 1 = "Not True" to 3 = "Certainly True". Completion of the SDQ took approximately five minutes. Scores range from 5 to 15 for each sub-measure. Lower scores were indicative of 'strength' in the sub-measures, while lower scores in SDQ-'Prosocial Behaviour' were indicative of difficulty.

5.2.3. *Procedure*

For the school sample, questionnaire packs were distributed to pupils during school time to be completed at home (see Appendix 4 Sections A4.1 and A4.2). For the database sample, participating families were sent their questionnaire packs via post. Before taking part in the study, children and parent(s) were asked to read through an information sheet and sign consent forms if they wished to participate. Families were informed the study was voluntary and any information they provided would be anonymous. Participating children and parent(s) were then asked to complete the questionnaire. Parent(s) were additionally asked to provide demographic information on their child, including their age, gender and any developmental difficulties. Participation in the questionnaire booklets took approximately 30 minutes. On completion, the questionnaires were either brought back to school by the children to be collected by the researcher, sent back to the university via a pre-paid envelope or given back

to the researchers during the laboratory study. This study received ethical approval from the University of Edinburgh Research Ethics Committee (62-1516/6).

5.2.4. *Statistical Analysis*

After cleaning the data and identifying multivariate outliers, Cronbach alphas were calculated for both the AQC and AQC-P total and subfactor scores in order to assess construct reliability and internal consistency. Furthermore, inter-item correlations on the total and subfactor scores were run to assess the degree of item homogeneity. Cronbach alphas above .700 and inter-item correlations above .300 were considered acceptable. Correlation matrices and regression analyses were conducted in order to assess the variance explained by the external correlates of alexithymia on both the AQC and AQC-P. Confirmatory factor analyses were then run on the novel AQC-P in order to compare the model fit with that found by Rieffe and colleagues (2006). A two- and three-factor structure were selected to be recovered from the data. As the AQC-P and AQC data were ordinal and measured on a 3-point Likert scale, it was predicted the robust maximum likelihood (RML) estimator would perform poorly (Li, 2016). Therefore, the analysis used the diagonally weighted least squares (DWLS) estimator to adjust the chi-square test statistic. Additionally, following the recommendations of Kline (2010), the suggested cut-offs <.060 for the root mean square error of approximation (RMSEA), <.080 for the standardised root mean square residual (SRMR) and >.900 for the comparative fit index (CFI) were used to assess model goodness-of-fit. Lastly, any significant gender, age and intra-rater differences on the AQC and AQC-P scores were identified using an analysis of variance (ANOVA) and independent sample t-tests. The main analysis was conducted using SPSS version 22 (SPSS, Chicago, IL, USA) and the CFA analysis was run using the lavaan package on R (Rosseel, 2012).

5.3. Results

5.3.1. *Data Cleaning*

Prior to conducting the main analysis, the extent of missing data was assessed. It was discovered sixteen children and fifteen parent(s) omitted one or two items of their respective alexithymia measures, with a further seven children omitting one item from the depressive symptom measure. The mean scores of the particular items were inserted in order to generate full scores. Parent(s) were asked to provide information on any learning or developmental difficulties their child had that may influence the data collected from the questionnaires. This was done to ensure only typically developing children were included in the current study. It was found twelve children had dyslexia, two children had dyspraxia, one child had audio processing difficulties and one child had a speech delay. An additional five children had autism spectrum disorder within the family, however they themselves had not been formally diagnosed with autism. While these children were not excluded from the analysis, five children had received a formal diagnosis of ASC and were therefore removed from the dataset. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. Lastly, in order to identify any multivariate outliers, Mahalanobis' distances were calculated. With the alpha set at <.001, it was found one participant was above the critical value of 20.52. Therefore, the participant was removed from the dataset, giving a final sample size of 250.

5.3.2. *Preliminary Analysis*

The means, standard deviations and ranges of the key variables were explored (Table 5.1).

Table 5.1

Means, standard deviations and ranges of the key variables.

Measure	Mean	α	SD	Range
AQC	35.51	.751	5.75	22 – 51
AQC- P	32.78	.822	6.01	20 – 51
DSRS	7.61	.948	4.64	0 – 22
EQ-C	39.42	.856	8.68	8 – 54
SDQ	39.84	.722	4.05	30 – 52

Note. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent, DSRS: Depression Self Rating Scale, EQ-C: Empathy Quotient – Child, SDQ: Strengths and Difficulties Questionnaire.

5.3.3. *Reliability*

5.3.3.1. Internal consistency and item homogeneity

In order to assess the internal consistencies, Cronbach alphas were generated for the AQC and AQC-P (see Table 5.2). The overall AQC produced an acceptable Cronbach alpha (α = .731). Furthermore, acceptable internal consistencies for the AQC subfactors DIF (α = .770) and DDF (α = .700) scores were found, with inter-item correlations above the acceptable level of .300. However, similar to the findings of Rieffe and colleagues (2006), the EOT subfactor did not meet the acceptable level of internal consistency and item homogeneity (α = .403 and .079, respectively).

The overall AQC-P produced an acceptable Cronbach alpha (α = .822). The DIF subfactor of the novel AQC-P showed good internal consistency (α = .843) and acceptable inter-item homogeneity (.433). However, both the DDF and EOT subfactors did not meet the criteria for internal consistency (α =.652 and α = .655, respectively) and item homogeneity (.272 and .192, respectively).

Table 5.2.

Cronbach alphas and inter-item correlations of the AQC/AQC-P total and subfactor scores.

Measure	Subfactor	A	Inter-item correlation	Mean	SD
AQC total		.751		34.91	5.86
	DIF	.770	.324	11.41	3.03
	DDF	.700	.341	8.85	2.43
	EOT	.408	.079	15.24	2.56
AQC-P total		.822		32.44	5.99
	DIF	.843	.433	10.15	2.83
	DDF	.652	.272	7.59	2.02
	EOT	.655	.192	15.04	3.05

Note. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, SD: Standard Deviation.

5.3.3.2. Correlations between total and subfactor scores across raters.

The total AQC and AQC-P scores were significantly correlated ($r = .325$, $p < .001$). At the subfactor level, child and parent DIF ($r = .401$, $p < .001$), DDF ($r = .206$, $p < .001$) and EOT ($r = .345$, $p < .001$) all showed significant correlations.

5.3.4. *Evidence of Validity Based on Relations to Other Variables: Concurrent Evidence*

5.3.4.1. Correlational analysis.

A Pearson's correlation matrix investigating the relationships between the alexithymia measures and depressive symptoms (DSRS), empathy (EQ-C) and positive and negative behaviour (SDQ) showed that both the AQC and AQC-P shared similar relationships with the external correlates of alexithymia (see Table 5.3). In order to assess if the correlation coefficients were significantly different, Fisher r-to-z transformations were computed. These showed that the AQ-C was significantly more correlated with depressive symptoms

compared to the AQC-P ($Z_{observed}$ = 4.87, p <.001). Conversely, the AQC-P was significantly more correlated with EQ-C ($Z_{observed}$ = -2.82, p = .005), SDQ- 'Prosocial Behaviour' ($Z_{observed}$ = -3.21, p = .001), SDQ-'Inattention-Hyperactivity' ($Z_{observed}$ = -2.17, p = .030) and SDQ- 'Conduct Problems' ($Z_{observed}$ = -2.09, p = .036) scores compared to the AQC.

Table 5.3.

Correlations between the AQC, AQC-P and external measures.

Measure	Subfactor	AQC	AQC-P	$Z_{observed}$
DSRS		.628***	.291***	4.87***
EQ-C		-.281***	-.495***	-2.82**
SDQ	*Prosocial Behaviour*	-.239***	-.487***	-3.21**
	Inattention- Hyperactivity	.204**	.382***	-2.17*
	Emotional Symptoms	.238***	.296***	n.s
	Conduct Problems	.200**	.372***	-2.09*
	Peer Problems	.066	.120	n.s

Note. DSRS = Depression Self Rating Scale; EQ-C = Empathy Quotient – Child; SDQ = Strengths and Difficulties Questionnaire. *p < .05, **p < .01, ***p < .001, n.s = non-significant.

5.3.5. *Regression Analyses*

Following on from the correlational analyses, multiple step-wise linear regressions were conducted in order to investigate the proportion of variance explained by depressive symptoms, empathy and behavioural strengths and weaknesses of the AQC and AQC-P scores (see Tables 5.4 and 5.5). Depressive symptoms emerged as the strongest predictor of AQC scores, explaining 39.20% of the variance (F(1, 247) = 160.71, p <.001). A further 1.10% of the variance was significantly explained by SDQ- 'Prosocial Behaviour' (F(2, 246) = 85.92, p <.001). None of the other external variables emerged as significant predictors. A Durbin Watson statistic of 1.81 suggested the regression model was unaffected by autocorrelation between the residuals (see Appendix 4 Section A4.3 for regression plots).

Table 5.4.

Multiple linear regression analysis with AQC scores as the dependant variable.

Model	Predictor	β	t	p	R^2	VIF
1	DSRS	.628	12.68	.000	.394	1.00
2	DSRS	.604	12.10	.000		1.06
	SDQ: Prosocial Behaviour	-.127	-2.54	.012	.405	1.06

Note. AQC: Alexithymia Questionnaire for Children, DSRS: Depression Self Report Scale, SDQ: Strengths and Difficulties Questionnaire, VIF: Variance Inflation Factor.

For the AQC-P scores, empathic behaviour emerged as the strongest predictor in the regression model, explaining 24% of the variance ($F(1, 247) = 77.89$, $p < .001$). SDQ-'Emotional Symptoms' ($F(2, 246) = 47.66$, $p < .001$), SDQ-'Prosocial Behaviour; ($F(3, 245) = 36.68$, $p < .001$) and SDQ-'Inattention-Hyperactivity' ($F(4, 244) = 30.32$, $p < .001$) also emerged as significant predictors, explaining 3.90%, 2.20% and 2.00% of AQC-P scores, respectively. Lastly, depressive symptoms were a significant predictor explaining 1.10% of the variance ($F(5, 243) = 25.63$, $p < .001$). The Durbin Watson statistic (1.75) revealed no substantial autocorrelation between the residuals (see Appendix 4 Section 4.3 for regression plots).

5.3.6. *Factor Structure and Model Fit*

In order to investigate if the original three factor structure (DIF, DDF and EOT) proposed by Bagby and colleagues (1994) could be recovered from the AQC-P, confirmatory factor analyses were run. Previously conducted exploratory factor analyses by Erni, Lötscher and Modestin (1997) have suggested a two factor structure (where DIF and DDF are merged together, known as 'DDIF') may be a more suitable extraction. The fit of both a three factor

Table 5.5.

Multiple linear regression analysis with AQC-P scores as the dependant variable.

Model	Predictor	β	t	p	R^2	VIF
1	EQ	-.490	-8.83	.000	.240	1.000
2	EQ	.-449	-8.12	.000	.279	1.04
	SDQ: Emotional Symptoms	.203	3.67	.000		1.04
3	EQ	-.251	-3.10	.002	.301	1.38
	SDQ: Emotional Symptoms	.200	3.69	.000		1.04
	SDQ: Prosocial Behaviour	-.265	-3.23	.001		1.20
4	EQ	-.181	-2.17	.031	.321	1.57
	SDQ: Emotional Symptoms	.190	3.56	.000		1.20
	SDQ: Prosocial Behaviour	-.250	-3.15	.002		1.04
	SDQ: Inattention-Hyperactivity	.171	2.84	.005		1.20
5	EQ	-.154	-1.84	.047	.332	1.93
	SDQ: Emotional Symptoms	.150	2.66	.008		1.21
	SDQ: Prosocial Behaviour	-.254	-3.23	.008		1.16
	SDQ: Inattention-Hyperactivity	.167	2.77	.006		1.21
	DSRS	.126	2.22	.028		1.18

Note. AQC-P: Alexithymia Questionnaire for Children – Parent, DSRS: Depression Self Rating Scale, EQ: Empathy Quotient, SDQ: Strengths and Difficulties Questionnaire, VIF: Variance Inflation Factor.

structure (model 1; DIF, DDF and EOT) and a two factor structure (model 2; DDIF and EOT) of the AQC-P data were therefore compared. Table 5.6 shows the fit statistics for all models. The DWLS estimator produced a non- significant chi square goodness of fit test for the three factor model [χ^2 (149) = 125.30, p = .930] but not the two factor model [χ^2 (151) = 206.20, p = .002]. The criteria for adequacy of fit were met for the three factor model, as satisfactory values for the CFI (>.900), RMSEA (< .060), SRMR <.080) emerged from the analysis. Despite an adequate SRMR value, no other goodness of fit tests were met in the two factor model.

Table 5.6.

Confirmatory factor analyses of the two and three factor solutions on the AQC-P.

		DWLS					
		χ^2	df	p	RMSEA	SRMR	CFI
AQC-P	Model 1: 3 Factor	124.30	149	.930	.051	.055	.902
	Model 2: 2 Factor	206.20	151	.002	.069	.072	.821

Note. DWLS = Diagonally Weighted Least Squares; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean square residual; CFI = comparative fit index.

5.3.7. *AQC and AQC-P Intra-Rater Effects*

5.3.7.1. Gender and age effects on AQC/AQC-P scores

In order to investigate if there were significant age and gender effects on the AQC and AQC-P scores, ANOVAs were conducted. Participant age was dichotomised into 8 to 10 year olds and 11 to 13 year olds. The ANOVAs revealed no significant effect of age or gender on either AQC ($F(3, 246) = 1.23$, $p = .300$) or AQC-P ($F(3,246) = 1.01$, $p = .387$) scores. Post-hoc Tukey HSD analysis confirmed no significant age or gender group differences.

5.3.7.2. Rating differences between the AQC and AQC-P

In order to investigate if there were significant rating differences between the AQC and AQC-P scores, further ANOVAs were conducted. Overall, children rated themselves more alexithymic than their parent/guardian ($F(498) = 26.48$, $p < .001$). At the subfactor level, children gave higher DIF ($F(498) = 23.45$, $p < .001$) and DDF ($F(498) = 40.29$, $p < .001$) ratings. However, there was no significant difference between parent and child EOT scores ($F(498) = .602$, $p = .438$).

5.3.8. *Split-Half Reliability of the AQC-P*

In order to assess the split-half reliability of the AQC-P, two Spearman-Brown split-half analyses were conducted. Firstly, the items of the AQC-P were divided from 1 to 10 and 11 to 20, giving an equal length split-half reliability coefficient of .777. Secondly, the items were divided into odd and even numbers (i.e., 1, 3, 5… and 2, 4, 6…), giving an equal length split-half reliability coefficient of .885.

5.4. Discussion

While attempts have been made to develop a parent-report measure of alexithymic traits in children (JASC-TF, Fukunishi et al., 1998; CAM, Way et al., 2010), previous studies have found they fail to share a significant relationship with self-reports of alexithymia (Griffin et al., 2016). Furthermore, the majority of the past literature have relied solely on self-reported measures to assess early-life alexithymia (e.g., the AQC), with the CAM only being utilised three times since publication. As such, little research has been previously conducted in order to identify a valid and reliable parent-reported measure. This is a cause for concern as a valid parent-report may circumvent the possible issues of administering self-reports to young populations (Myers & Winters, 2002). In light of this, researchers have suggested it would be beneficial to administer one measure with the same items to both children and their parent(s) in order to alleviate comparison issues (Griffin et al., 2016). While a parent-reported version of the AQC (Rieffe et al., 2006) has been recently developed (AQC-P; Costa et al., 2017) the original authors did not assess its psychometric properties and the measure has not been administered to other populations since its publication. Consequently, it remained unclear if the AQC-P was an appropriate measure of early-life alexithymia. Therefore, the main objective of the current study was to report evidence of the validity and reliability of the AQC-P.

It was found the AQC-P is a psychometrically robust measure of child alexithymia with congruent validity. At the total score and subfactor level, the self-and peer report AQs were significantly correlated. These correlations were in the typical range expected when comparing self- and parent-reported measures of child psychopathology ($r = .200$ to $.500$; De Los Reyes & Kazdin, 2005). Furthermore, the full AQC and AQC-P yielded good internal consistencies ($\alpha > .700$ and $\alpha > .800$, respectively). Similar to previous findings, the internal consistency of the EOT subfactor within the AQC was relatively poor, while the DDF and DIF subfactors remained acceptable (Rieffe et al., 2006). Within the AQC-P however, the DDF and EOT subfactors were just below acceptable levels of internal consistency ($\alpha < .700$), a similar pattern seen in the use of the AQC (Cerutti et al., 2017). Therefore, it appears the AQC-P has similar psychometric properties to the AQC.

Furthermore, evidence in support of the construct validity of AQC-P was found. Both the AQC and AQC-P correlated significantly with most of the external variables assessed, other than the Strengths & Difficulties questionnaire subfactor 'Peer Problems'. Despite this, it appeared each measure shared a unique correlation pattern with the other rating scales. Compared to the AQC, the AQC-P correlated significantly more negatively with prosocial and altruistic behaviour, known to be deficit in alexithymic individuals (Taylor et al., 1999; FeldmanHall, Dalgleish & Mobbs, 2013). In contrast, the AQC was significantly more positively correlated with depressive symptom scores. It may be possible that alexithymic children, while being able to report on their negative mood state, were unable to recognise the external negative behaviours that are associated with alexithymia, such as reduced empathic, altruistic and prosocial behaviour. Moreover, caregivers may be able to better identify external difficulties, but may fail to recognise their child's internal struggles, such as depressive symptoms. Supporting this, children were significantly more likely to report difficulties in identifying and describing their feelings compared to their caregivers, while

there were no significant differences in the ratings of externally oriented thinking. It therefore appears that both instruments, while producing similar overall ratings, detect different degrees of cognitive and behavioural difficulties associated with alexithymia.

Finally, it was of interest to assess the factorial structure of the AQC-P by investigating the fit of three- and two-factor models on the data. While the two factor structure proposed by Erni and colleagues (1997) failed to reach the acceptable limits of model fit, the three-factor model met all the goodness of fit tests. Therefore, it appeared a three-factor structure was the most suitable representation of the AQC-P, consistent with the findings in child (Rieffe et al., 2006), adolescent (Säkkinen, Kaltiala-Heino, Ranta, Haataja & Joukamaa, 2007) and adult (Taylor, Bagby & Parker, 2003) samples using the TAS-20.

5.4.1. *Limitations*

The current study has some limitations. It has a relatively limited sample size which would suggest that the results should be considered as preliminary and need replication in both neurotypical and non-neurotypical samples. Bias may have also been introduced by sampling limitations. However, the current study's response rates are not unusual for opportunistic recruitment in the general public (Kaplowitz, Hadlock & Lavine, 2004).

5.4.2. *Conclusion*

The findings from this novel study indicate the AQC-P is a psychometrically sound measure of child alexithymia that can be administered to parents or guardians of children as young as eight. Furthermore, the AQC-P may be used independently or in tandem with the AQC. By using both measures together, a greater breadth of a child's alexithymic traits may be detected. Additionally, it is possible the administration of the AQC-P may circumvent the potential issues that arise in auto-evaluative measures of alexithymic traits and provide a greater understanding of a child's behavioural difficulties that they themselves may not be

aware of. These findings could aid future research and enhance the understanding of alexithymia's antecedents and sequelae within child samples.

Chapter 6

Empirical Study 5:

THE MEDIATING ROLE OF CHILD ALEXITHYMIA ON THE RELATIONSHIP BETWEEN MALADAPTIVE EMOTION REGULATION AND EARLY-LIFE DEPRESSIVE SYMPTOMS

6.1. Introduction

Results from the previous chapter indicated both the AQC and AQC-P are valid measures of early-life alexithymia. Considering this, it was next of interest to assess the potential mediating role of alexithymia on the known association between emotion dysregulation and early-life depressive symptoms. In order to cross-validate the findings, both AQC and AQC-P total and subfactor scores will be used in the mediating models.

It has been suggested the development, chronicity and recurrence of early-life mood disorders may be a sequelae of maladaptive emotion regulation (Rottenberg & Gross, 2007; Joormann & Gotlib, 2010). Emotion regulation, defined as the processes through which emotional awareness and experiences are monitored, maintained and modified (Thompson, 1994), is thought to consist of two overarching control strategies that modulate emotional experience (Gross, 1998). Antecedent-Focused Regulation, or cognitive reappraisal, is employed *prior* to an emotional response and includes the re-evaluation of a situation in order to reduce its emotional impact (McCarthy, Lambert & Moller, 2006). In contrast, Response-Focused Regulation, or expressive suppression, is the inhibition of external actions (e.g., facial expression, vocal prosody or hand gestures) *subsequent* to the formation of an

emotional response. These two emotion regulation strategies are used in everyday life, both in children (Gullone & Taffe, 2011) and adults (Gross & John, 2003). While it has been suggested that cognitive reappraisal may be a helpful, adaptive emotion regulation strategy, expressive suppression is thought to be maladaptive. Within adults, expressive suppression has been linked with decreased reports of well-being, life satisfaction and experience of positive emotions (John & Gross, 2004). Furthermore, a lower utilisation of cognitive reappraisal strategies has been found to be associated with many negative psychological consequences (Butler et al., 2003) including prolonged rumination (Ray et al., 2005), worsening of anxiety symptoms (Goldin, Manber-Ball, Werner, Heimberg & Gross, 2009) and a decreased response to cognitive behavioural therapy (Clark & Beck, 2010).

Previous studies have also examined the influence of maladaptive emotion regulation strategies in childhood. Similar to adults, children who demonstrate higher use of expressive suppression and lower use of cognitive reappraisal are more likely to be diagnosed with anxiety disorders (Carthy, Horesh, Apter & Gross, 2010) and report elevated levels of depressive symptomatology (Betts, Gullone & Allen, 2009).

However, to date, the potential association between maladaptive emotion regulation and early-life alexithymia has not been investigated. Furthermore, if alexithymia mediates the relationship between maladaptive emotion regulation and depressive symptoms is currently unknown. Alexithymia has been previously shown to be a significant mediating factor between many psychological phenomena in adult populations, such as childhood trauma and non-suicidal self-injury (Paivio & McCulloch, 2004), experiences of sexual abuse and psychological distress (Hébert, Boisjoli, Blais & Oussaïd, 2018) and avoidant attachment and interpersonal problems (Koelen, Eurelings-Bontekoe & Kempke, 2016). However, as previously stated, the mediating role of early-life alexithymia between adverse psychological phenomena in children remains little understood. In other words, alexithymia may explain in

whole or in part the relationship between maladaptive emotion regulation and depressive symptoms. While depressive symptoms are amenable to identification and treatment in children (Weisz, McCarty & Valeri, 2006), there are few, as yet, evidence based interventions available to specifically address alexithymic traits. Therefore, if alexithymia does have a significant mediating role in the relationship between maladaptive emotion regulation and depressive symptoms, the current study may illuminate the need to develop strategies to target alexithymic traits in children with maladaptive emotion regulation.

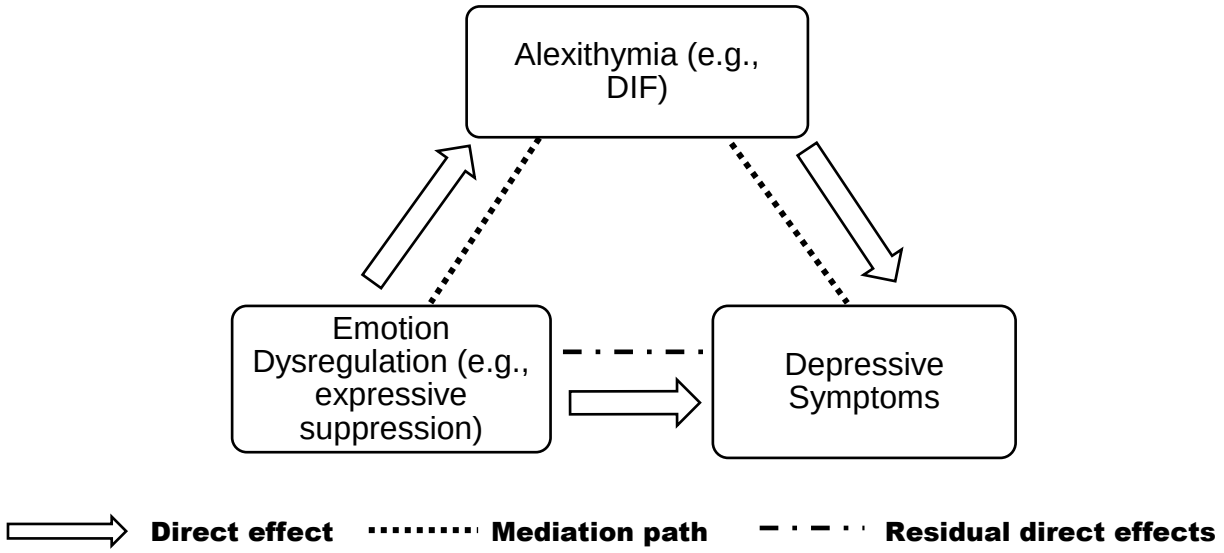

Figure 6.1. *Hypothetical mediation model, with emotion regulation as the independent variable, depressive symptoms as the dependant variable and alexithymia as the mediator.*

6.1.1. *The Current Study*

This chapter therefore aims to address the lack of research in children in this area. The study will be the first to assess the relationships between measures of alexithymia, depressive symptoms and emotion regulation in children and the first to investigate the potential mediating effect of alexithymia on the relationship between maladaptive emotion regulation and depressive symptoms. Lastly, the current empirical chapter will be the first to investigate the separate contributions of the AQC and AQC-P subfactors on this relationship.

6.2. Method

6.2.1. *Participants*

Participants were a subset of the sample analysed in Chapter 5 who took part in the questionnaire dissemination in two schools in the UK. The current study's sample consisted of 94 boys and 106 girls with a mean age of 10.30 years (SD = .900). Participant age ranged from 8 to 13 years old.

6.2.2. *Materials*

As the participants analysed in this chapter were a subset of the sample recruited in Chapter 5, a full overview of the Alexithymia Questionnaire for Children (AQC), the Alexithymia Questionnaire for Children - Parent (AQC-P) and the Depression Self-Rating Scale (DSRS) can be found within that empirical chapter.

6.2.2.1. Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA)

The Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; Gross & John, 2003) consists of ten items investigating the emotion regulation strategies cognitive reappraisal (henceforth 'CR') (e.g., "When I want to feel happier, I think about something different") and expressive suppression (henceforth 'ES') (e.g., "I keep my feelings to myself"). The scale is considered to have good internal consistency ($\alpha > .700$) (Gross & John, 2003). Items were rated on a 5-point Likert Scale, from 1 = "Strongly Disagree" to 5 = "Strongly Agree". Completion of the EQC-CA took approximately three minutes. Scores ranged from 10 to 50, with higher scores indicating fewer difficulties with emotion regulation (see Appendix 5 Section A5.1).

6.2.3. *Procedure*

For the school sample, questionnaire packs containing the measures were distributed to pupils during school time to be completed at home. For the database sample, participating

families were sent their questionnaire packs via post. Before taking part in the study, children and parents were asked to read through an information sheet and sign a consent form if they wished to participate. Families were informed the study was voluntary and any information they provided would be anonymous. Participating children and parents were then asked to complete the questionnaire. Parent(s) were additionally asked to provide demographic information on their child, including their age, gender and any developmental difficulties. Participation in the questionnaire booklet took approximately thirty minutes. On completion, the questionnaires were brought back to school by the children to be collected by the researcher. This study received ethical approval from the University of Edinburgh Research Ethics Committee (62-1516/6).

6.2.4. *Statistical Analysis*

After cleaning the dataset, testing underlying assumptions and excluding multivariate outlier(s), correlations were computed in order to assess the relationships between total DSRS (depressive symptoms) AQC (alexithymia – self report), AQC-P (alexithymia – parent report) and ERQ-CA (emotion regulation) scores. After statistically significant relationships were established, mediation analyses were run using the SPSS macro PROCESS (model 4) (Hayes, 2012) in order to investigate the mediating role of alexithymia on the relationship between emotion regulation and depressive symptoms. Ninety five percent confidence intervals of the standard error were bootstrapped with 5000 samples in order to assess if the mediation effect was significant (Preacher & Hayes, 2008). Meditation was considered significant when the bias corrected and accelerated 95% confidence intervals of the indirect effect did not include zero. If a significant mediation effect of global alexithymia was identified, the ERQ-CA scores were then parsed into CR (cognitive reappraisal) and ES (expressive suppression) scores. Furthermore, the AQC and AQC-P were parsed into DIF, DDF and EOT scores. Correlation and mediation analyses were then rerun in order to identify any significant

mediation roles of the AQC/AQC-P subfactors on the relationship(s) between the cognitive reappraisal, expressive suppression and depressive symptoms.

6.3. Results

6.3.1. *Data Preparation*

Prior to conducting data analysis, the degree of missing data was assessed. Nine children and ten parent(s) missed between one and two items of their respective alexithymia measures, with an additional five children omitting one item of the DSRS measure. The average scores of the particular items were inserted in order to generate full scores. Parent(s) were asked to provide information on any learning or developmental difficulties their child had to ensure only typically developing children were included. It was found seven children had dyslexia, one child had audio processing difficulties and one child had a speech delay. An additional five children had autism spectrum conditions (ASC) within their immediate family, however the child themselves had not received a formal diagnosis. Furthermore, none of the parent(s) indicated their child was taking psychotropic medication nor having any psychological interventions at the time of study involvement. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. Lastly, Mahalanobis' distances were calculated in order to identify significant multivariate outliers within the dataset. With the alpha set at $p < .001$, it was found one participant was over the critical chi-square value of 20.52. The participant was removed from the dataset and the final sample size was 199.

6.3.2. *Preliminary Analysis*

The means, standard deviations, ranges and Cronbach alphas of the key variables are described in Table 6.1.

Table 6.1.

Means, standard deviations and Cronbach alphas of AQC, AQC-P, DSRS and ERQ-CA scores.

Measure	Mean	SD	Range	α
AQC	34.93	5.87	22 – 51	.751
DIF	11.02	2.97	7 – 12	.771
DDF	8.67	2.48	5 – 15	.721
EOT	15.26	2.56	8 – 23	.401
AQC-P	32.47	5.99	20 – 51	.819
DIF	9.90	2.80	7 – 21	.826
DDF	7.57	1.94	5 – 14	.689
EOT	15.00	2.99	8 – 22	.643
DSRS	7.19	4.70	0 – 22	.954
ERQ-CA	33.52	5.67	14 – 45	.729
CR	20.19	5.25	6 – 30	.824
ES	13.37	3.29	5 – 20	.703

Note. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent, DSRS: Depression Self-Rating Scale, ERQ-CA: Emotion Regulation Questionnaire for Children and Adolescents.

As there is no published normative data using a large sample of children, cut-off scores for the AQC/AQC-P have yet to be established. However, cut-off scores have been generated for the depressive symptom measure (Ivarsson & Gillberg, 1997). Only 3.50% of children had no depressive symptoms (DSRS score of 0). 31.00% of the children tested had low depressive symptom scores (DSRS scores between 1 - 4), 23.50% had moderate depressive symptom scores (DSRS scores between 5 – 7) and 42% had high depressive symptom scores (DSRS scores between 8 – 22). Furthermore, using the suggested cut-off

score of 15 (Ivarsson & Gillberg, 1997), 8.50% of the children met the cut-off for clinical depression (Birleson, Hudson, Buchanan & Wolff, 1987).

6.3.3. *Total Score Correlational Analysis*

Pearson correlations suggested there were significant associations between of all of the variables' total scores. AQC scores were found to correlate significantly with AQC-P ($r = .381$, $p < .001$) DSRS ($r = .648$, $p < .001$) and ERQ-CA ($r = .648$, $p < .001$) scores. Furthermore, AQC-P scores correlated significantly with DSRS ($r = .359$, $p < .001$) and ERQ-CA ($r = -.284$, $p < .001$) scores. Lastly, DSRS and ERQ-CA scores correlated significantly ($r = -.359$, $p < .001$).

6.3.4. *Identifying Confounding Variables*

In order to identify any confounding variables for the later analysis, correlational analysis and independent sample t-tests were conducted in order to identify any significant effects of participant age, gender or developmental difficulties on the key variables.

6.3.4.1. Participant age

Participant age was not found to correlate significantly with total AQC ($r = -.119$, $p = .094$), AQC-P ($r = -.016$, $p = .825$), DSRS ($r = -.077$, $p = .278$) and ERQ-CA ($r = -.086$, $p = .225$) scores.

6.3.4.2. Participant gender

Independent sample t-tests revealed no significant gender effect on AQC, ($t(197) = .308$, $p = .759$), AQC-P ($t(197) = 1.85$, $p = .066$), DSRS ($t(197) = -.596$, $p = .552$) or ERQ-CA ($t(197) = -1.60$, $p = .111$) scores.

6.3.4.3. Developmental difficulties

Independent sample t-tests revealed no significant effect of participant developmental difficulties on total AQC ($t(197) = .756$, $p = .467$), DSRS ($t(197) = -.301$, $p = .764$) or ERQ-CA ($t(197) = .601$, $p = .542$) scores. However, children with developmental difficulties were found to have significantly higher AQC-P scores ($t(197) = -2.92$, $p = .004$).

6.3.5. *The Mediating Role of Alexithymia on the Relationships between Global Emotion Regulation and Depressive Symptoms*

In order to establish if alexithymia had a mediating role in the relationship between global emotion regulation and depressive symptoms, mediation analyses were conducted with ERQ-CA score as the independent variable, DSRS score as the dependant variable and AQC/AQC-P score as the mediator. As a significant effect of participant developmental difficulties was identified on AQC-P score, this was entered into AQC-P mediation model (model 2) as a covariate. Results are shown in Table 6.2. Total AQC scores were found to significantly partially mediate the relationship between total ERQ-CA and DSRS scores [95% CI: -.243, -.077], with the direct effect remaining significant [95% CI: -.239, -.058]. Furthermore, a significant partial mediation of AQC-P scores on the relationship between ERQ-CA and DSRS scores was identified [95% CI: -.115, -.030], as the direct effect remained significant [95% CI: -.342, -.123].

6.3.6. *Correlational Analysis between the Three Alexithymia Constructs, Depressive Symptoms, Expressive Suppression and Cognitive Reappraisal*

As a partial mediating effect of total AQC and AQC-P scores was identified, it was next of interest to identify which of the AQC/AQC-P subfactor(s) explained this mediating role. Furthermore, it was of interest to assess which emotion regulation style(s) were

mediated by alexithymia. On parsing the ERQ-CA into the CR and ES subfactors and AQC/AQC-P into the DIF, DDF and EOT subfactors, a correlation matrix was computed in

Table 6.2.

Mediation analyses with total ERQ-CA score as the independent variable, DSRS score as the dependant variable and AQC/AQC-P as the mediator, controlling for participant developmental difficulties in model 2.

Model	IV	M	B	SE	BootLLCI	BootULCI	Model R^2
1	ERQ-CA	AQC	.478	.044	.338	.565	.371***
	Total effects (c)		-.147	.046	**-.243**	**-.077**	
	Direct effects (c')		-.146	.042	**-.239**	**-.056**	
2	ERQ-CA	AQC-P	.227	.053	.122	.333	.203***
	Total effects (c)		-.066	.022	**-.115**	**-.030**	
	Direct effects (c')		-.232	.055	**-.342**	**-.123**	

Note. IV: Independent variable, M: mediator variable, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent, ERQ-CA: Emotion Regulation Questionnaire for Children and Adolescents, DSRS: Depression Self-Rating Scale. Significant mediation is indicated with bold font confidence intervals. *** $p < .001$.

order to identify the relationships between the two emotion regulation strategies, three alexithymia constructs and depressive symptoms (see Table 6.3).

CR was found to correlate negatively with total AQC ($r = -.266$, $p < .001$), AQC-P ($r = -.338$, $p < .001$) and DSRS scores ($r = -.337$, $p < .001$). Furthermore, ES was found to correlate significantly with both AQC ($r = .184$, $p = .009$) and DSRS ($r = .181$, $p = .011$) but not AQC-P ($r = .064$, $p = .366$) scores.

At the AQC subfactor level, DDF was found to correlate significantly with CR ($r = -.369$, $p < .001$) whereas both DIF ($r = -.091$, $p = .199$) and EOT ($r = -.030$, $p = .675$) shared a non-significant correlation. Furthermore, EOT was found to correlate significantly with ES

Table 6.3.

Correlational matrix of AQC, ACQ-P, ERQ-CA and DSRS total and subfactor scores.

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. AQC	/	.811***	.828***	.551***	.381***	.338***	.280***	.263***	-.307***	-.266***	.184**	.648***
2. DIF		/	.646***	.075	.276***	.429***	.186*	.029	-.145*	-.091	.130	.575***
3. DDF			/	.183	.284***	.261***	.270***	.149*	-.315***	-.369***	.045	.569***
4. EOT				/	.278***	.022	.166*	.428***	-.230**	-.030	.247***	.271***
5. AQC-P					/	.758***	.809***	.767***	-.284***	-.338***	.064	.359***
6. DIF						/	.524***	.239***	-.214***	-.243***	.054	.359***
7. DDF							/	.479***	-.220***	-.282***	.086	.298***
8. EOT								/	-.225***	-.266***	.022	.189**
9. ERQ-CA									/	.815***	.664***	-.359***
10. CR										/	.109	-.337***
11. ES											/	.181*
12. DSRS												/

Note. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent; DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, ERQ-CA: Emotion Regulation Questionnaire for Children and Adolescents, CR: Cognitive Reappraisal, ES: Expressive Suppression, DSRS: Depression Self-Rating Scale. *p <.05, **p <.01, ***p <.001.

(r = .247, p <.001), whereas neither DIF (r = .130, p = .067) or DDF (r = .045, p = .523) shared a significant correlation. Lastly, all three of the AQC subfactors correlated significantly with DSRS score; DIF (r = .575, p <.001), DDF (r = .591, p <.001) and EOT (r = .271, p <.001).

While the AQC-P subfactors DIF, DDF and EOT were found to correlate significantly with CR scores (r = -.243, p = .001; r = -.282, p <.001; r = -.266, p <.001, respectively), no significant correlations were identified with ES scores (r = .054, p = .445; r = .086, p = .230; r = .022, p = .753, respectively). Furthermore, DIF, DDF and EOT correlated significantly with DSRS scores (r = .359, p <.001; r = .298, p <.001; r = .189, p = .008).

6.3.7. *The Mediating Role of Self-Reported Alexithymia on the Relationships between Cognitive Reappraisal, Expressive Suppression and Depressive Symptoms*

From the results of the correlation matrix, a unique relationship between the AQC subfactor DDF and the ERQ-CA subfactor CR emerged. Furthermore, DSRS scores were found to correlate with these two subfactors significantly. Therefore, mediation analysis was run in order to investigate if self-reported DDF played a mediation role in the relationship between CR and DSRS scores. Results are shown in Table 6.4. Mediation analysis revealed a non-significant mediating role of DDF [95% CI: -.175, .016], with the direct effect remaining significant [95% CI: -.427, -.184].

Table 6.4.

Mediation analyses with CR score as the independent variable, DSRS score as the dependant variable and AQC subfactor DDF as the mediator.

IV	M	B	SE	BootLLCI	BootULCI	Model R^2
CR	DDF	-.066	.029	.267	.612	.136***
Total effects (c)		-.068	.044	-.175	.016	
Direct effects (c')		-.306	.044	**-.427**	**-.184**	

Note. IV: Independent variable, M: mediator variable, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval. DDF: Difficulty Describing Feelings, CR: Cognitive Reappraisal, DSRS: Depression Self-Rating Scale. Significant mediation is indicated with bold font confidence intervals. *** $p < .001$.

An additional exclusive relationship emerged between self-reported EOT and ES. Furthermore, DSRS scores were found to correlate significantly with the two subfactors. Mediation analysis was therefore conducted in order to identify any significant mediating effect of EOT on the relationship between ES and DSRS score. Results are shown in Table 6.5. A partial mediation of EOT scores was identified [95% CI: -.139, -.012], with the direct effect remaining significant [95% CI: -.460, -.144].

Table 6.5.

Mediation analyses with ES score as the independent variable, DSRS score as the dependant variable and AQC subfactor EOT as the mediator.

IV	M	B	SE	BootLLCI	BootULCI	Model R^2
ES	EOT	.299	.132	.037	.561	.136***
Total effects (c)		-.071	.033	**-.139**	**-.012**	
Direct effects (c')		-.302	.080	**-.460**	**-.144**	

Note. IV: Independent variable, M: mediator variable, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval. EOT: Externally Oriented Thinking, ES: Expressive Suppression, DSRS: Depression Self-Rating Scale. Significant mediation is indicated with bold font confidence intervals. *** $p < .001$.

6.3.8. *The Mediating Role of Parent-Reported Alexithymia on the Relationship between Cognitive Reappraisal and Depressive Symptoms*

As significant relationships were established between total AQC-P, DSRS and CR scores, mediation analyses were run in order to investigate the potential mediating role of parent-reported alexithymia on the relationship between cognitive reappraisal strategies and depressive symptoms. The emotion regulation strategy ES was not included in the mediation analyses as it did not share a significant correlation with any of the AQC-P subfactors. As a significant effect of participant developmental difficulties was identified on total AQC-P score, this was inserted into the mediation model as a covariate. Results are shown in Table 6.6. On inspection of the 95% accelerated bias-corrected confidence intervals, a significant partial mediating role was identified [95% CI: -.178, -.034], with the direct effect remaining significant [95% CI: -.422, -.126]. On inspection of the individual AQC-P subfactor contributions, DDF [95% CI: -.132, -.031] scores were found to underpin the partial mediation effect between CR and DSRS scores. The DIF [95% CI: -.075, .014] and EOT subfactor [95% CI: -.050, .041] however was found to have a non-significant mediating role.

6.4. Discussion

Within adolescent and adult samples, previous studies have found significant relationships between alexithymic traits, depressive symptoms and maladaptive emotion regulation. Additionally, the negative health and psychological consequences of these phenomena are well documented in older populations. However, as much of the previous research has failed to investigate the interactions between depressive symptoms, alexithymia and emotion regulation strategies during childhood, the current chapter aimed to bridge this gap in the literature. Furthermore, it has been previously suggested children may lack the

Table 6.6.

Mediation analyses with CR score as the independent variable, DSRS score as the dependant variable and AQC-P subfactors DIF, DDF and EOT as the mediators, controlling for participant developmental difficulties.

IV	M	B	SE	BootLLCI	BootULCI	Model R^2
CR	DIF	-.066	.029	-.075	.014	.210***
	DDF	-.051	.023	**-.075**	**-.022**	
	EOT	-.003	.022	-.050	.041	
Total effects (c)		-.096	.047	**-.178**	**-.034**	
Direct effects (c')		-.274	.075	**-.422**	**-.126**	

Note. IV: Independent variable, M: mediator variable, B: unstandardized beta coefficients, SE: standard error, BootLLCI: bootstrapping lower limit confidence interval, BootULCI: bootstrapping upper limit confidence interval. AQC-P: Alexithymia Questionnaire for Children – Parent; DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, CR: Cognitive Reappraisal, DSRS: Depression Self-Rating Scale. Significant mediation is indicated with bold font confidence intervals. *** $p < .001$.

competence to report their alexithymic traits (Myers & Winters, 2002). As such, it was of interest to ascertain if both a self- and complementary parent-report measure of alexithymia would demonstrate a mediating effect on the relationship between maladaptive emotion regulation and depressive symptoms.

The first finding was the presence of significant positive relationships between global self- and parent-rated alexithymic traits, maladaptive emotion regulation and depressive symptoms. This is consistent with previous research suggesting that children with maladaptive regulation show higher levels of depressive symptoms (Betts et al., 2009; Kudinova et al., 2018). However, to the authors' knowledge, it is the first study to identify a significant relationship between alexithymia and global emotion dysregulation in a sample of children, consistent with research in adults (Swart et al., 2009).

The study's second finding identified unique patterns of associations of the three alexithymia constructs' correlations with the individual emotion regulation strategies. Children who rated themselves higher on EOT were found to utilise significantly more

expressive suppression in their emotion regulation. Considering both are associated with a tendency to inhibit and suppress outward emotional reactions (Li et al., 2017), previous authors in adult populations have identified strong associations with both psychological constructs (Chen et al., 2011). For example, in a recent neuroimaging study conducted by Li and colleagues (2017), increased grey matter volume in the ventromedial prefrontal cortex was associated with higher ratings on both EOT and ES, even when controlling for co-occurring depressive symptoms. In support of this, the current study identified a significant partial mediation of EOT on the relationship between ES and depressive symptoms. However, parent-rated alexithymia was not found to be significantly associated with expressive suppression, either at the total or subfactor domain. Considering expressive suppression requires the inhibition and masking of emotional reactions, it is unsurprising children themselves are aware of their expressive suppression and can successfully report on them. In contrast, parent(s) may be unable to detect when their child is suppressing their emotional reactions, in turn preventing them from accurately rating their child's utilisation of the maladaptive emotion recognition strategy.

In contrast, results from the correlational analysis suggested parent(s) are able to detect their child's difficulties reappraising emotional situations, with parent-rated alexithymia associating with decreased utilisation of cognitive reappraisal strategies both at the total and subfactor domain. In light of these associations, mediation analyses were run in order to identify which of the alexithymia construct(s) emerged as significant mediators. Results from the analyses revealed an exclusive partial mediating role of DDF in the relationship between CR and depressive symptom scores. Parent-rated DIF and EOT however did not emerge as significant mediators in this relationship. While the literature is scarce, it has been speculated high ratings on DIF and DDF are more closely associated with decreased use of cognitive reappraisal within adult populations (Bamonti et al., 2010). Considering the

emotion regulation strategy requires the capability to identify and label one's emotional experiences before they can be revaluated (Gross, 1998) it is somewhat unsurprising parent-reported DDF was found to have a mediating role in the relationship between cognitive reappraisal and depressive symptoms. It may be speculated that DIF's non-significant mediating role could be attributed to the fact a child's difficulty identifying feelings manifest within their inability to communicate their emotions to others. That is, to an observer, only the visible manifestations of the child's affective alexithymia may be detected. Therefore, parents may fail to recognise their child's inabilities to *identify* their feelings but may recognise their difficulties in *articulating* their emotions.

Interestingly, the direct effects remained significant in the mediation model. It is possible the unsuccessful use of cognitive reappraisal strategies may facilitate the exaggerated processing of negative emotional information. This in turn may cause individuals with elevated depressive symptoms to infer more negative interpretations of emotional situations and experiences (Wisco, 2009), further exacerbating their symptom severity and chronicity (Clark & Steer, 1996). While this maladaptive cognitive bias has been noted for some time in both clinical (Mathews & McLeod, 2005), and non-clinical (Bradley, Mogg & Lee, 1997) adults, more recent studies have found children at risk for depressive illness utilise a similar cognitive style (Cristea, Mogoașe, David & Cuijpers, 2015; Harrison & Gibb, 2015).

Therefore, it appears both difficulties in describing feelings and a lower utility of reappraisal strategies may contribute to the development and maintenance of depressive symptoms during childhood. However, while self-reported DDF was also found to be associated with cognitive reappraisal at the correlational level, it was found to non-significantly mediate the relationship between cognitive reappraisal and depressive symptoms. In light of this it appears children, while being able to successfully rate their

externally oriented cognitive styles, may lack the emotional understanding to differentiate between their depressive symptoms and their difficulties in identifying and describing their emotions, in support of the speculation made by Myers and Winters (2002). In contrast, parents may be unable to identify their child's inhibiting of emotional reactions, but can adequately rate their child's inability to describe their emotions. As such, results from the current study add to the notion that both a self- and a parent-report of alexithymia may usefully be administered when assessing alexithymia in child populations.

Confirming the notion put forward earlier, it appears alexithymic traits may be a target for intervention in children with maladaptive emotion regulation. In particular, children with elevated expressive suppression may benefit from strategies targeting their co-occurring externally oriented thinking. Likewise, children demonstrating difficulties cognitively reappraising may benefit from strategies targeting their difficulties identifying and articulating their emotions. By doing so, this may reduce the risk of depressive symptom onset and maintenance during childhood. To date, there is no clear evidence for treatment specifically targeting alexithymic tendencies in children. However, recent studies have highlighted the benefits of child-oriented mindfulness-based intervention strategies in the improvement of maladaptive emotion regulation (Flook, Goldberg, Pinger & Davidson, 2015) and symptoms of low mood (Crescentini, Capurso, Furlan & Fabbro, 2016) in young populations. Considering this, it may be that similar strategies could ameliorate early-life alexithymic traits. However, to date, this has not been examined and warrants further investigation (see Chapter 8 for further discussion).

6.4.1. *Strengths*

The current empirical chapter has a number of strengths. First, this is the first study to examine the mediating role of early-life alexithymia in the known relationship between maladaptive emotion regulation and depressive symptoms. In addition, the shared

associations between depressive symptoms, alexithymia and emotion regulation had not yet been explored in a sample of young children. Methodologically, the anonymity of the questionnaires was likely to have encouraged children and parent(s) to provide honest responses to the measures.

6.4.2. *Limitations*

As the sample utilised in the current study was drawn from the community, it would be valuable to replicate the study in a clinical sample. Depressive symptoms, alexithymia and maladaptive emotion regulation can be considered to lie on continua, even within neurotypical samples. It is therefore relevant to investigate these psychological constructs in both clinical and community-based populations. It would also be valuable to replicate the analyses in a longitudinal study where temporal relations between changes in symptoms across the three domains could be ascertained and where potential reciprocal influences between alexithymia, depression, and emotion regulation could be explored.

6.4.3. *Conclusion*

A complex mediating role of alexithymic traits was found in the relationship between emotion dysregulation and depressive symptoms. Parent-rated DDF partially mediated the relationship between cognitive reappraisal and depressive symptoms. In contrast, self-reported EOT partially mediated the relationship between expressive suppression and depressive symptoms. In light of this, it appears early targeted intervention strategies may be required to be tailored specifically to the alexithymic trait(s) and maladaptive emotion regulation strategy(s) the child presents. By recognising both during treatment, the potential short and long term consequences of childhood depressive symptoms may be ameliorated. However, future studies are required to develop and assess the utility of alexithymia-specific interventions, particularly mindfulness-based strategies.

Chapter 7

Empirical Study 6:

IDENTIFYING THE BEHAVIOURAL CORRELATES OF ALEXITHYMIA IN CHILDREN: FINDINGS FROM AN EMOTIONAL EXPRESSION MORPH PARADIGM

7.1. Introduction

So far in this body of literature, the co-administration of the AQC and AQC-P has identified some of the adverse psychological correlates and possible antecedents of child alexithymic traits. Considering the findings from Chapter 3, it was lastly of interest to identify a potential behavioural sequela of child alexithymia. This was done by replicating Chapter 3's methodology in a sample of healthy children by administering both psychometric measures of depressive, anxiety and alexithymic symptoms and a novel, child-friendly adaptation of the EEMT. As discussed earlier, previous studies have suggested alexithymia, not an autism diagnosis, predicts some of the psychosocial deficits in paediatric ASC samples (Trevisan et al., 2016). Furthermore, results from Chapter 5 identified significant associations between AQC-P scores and the majority of the SDQ subfactors, assessing adverse internalising/externalising behaviours. As such, it was also of interest to ascertain if early-life alexithymia remains a significant predictor of emotional processing difficulties once subclinical autistic traits and internalising/externalising behaviours are controlled for.

7.1.1. *The Influence of Autistic Traits on Emotion Recognition Abilities*

Autism is classically associated with a marked difficulty interpreting and responding to the social cues experienced in everyday life (Dawson et al., 2004). As such, individuals

with ASC have been found to exhibit deficits in their correct recognition of others' emotions (Guastella et al., 2010), both in auditory (Golan, Baron-Cohen, Hill & Rutherford, 2007) and visual (Black et al., 2017) emotional cues. While the majority of the previous literature has assessed group differences between those with a formal diagnosis of ASC versus neurotypical controls, a more recent approach is to assess autistic traits, most commonly measured by the Autism-Spectrum Quotient (Baron-Cohen et al., 2001). Even within the healthy general population, autistic traits fall on a wide continuum (Ruzich et al., 2015). In light of this, similar global deficits in emotion recognition abilities have been identified in healthy adults with elevated AQ scores (Luo, Burns & Xu, 2017). Furthermore, adults who score highly on the AQ have been found to make more errors identifying happy, sad and fearful emotional expressions compared to low scoring adults (Actis-Grosso, Bossi & Ricciardelli, 2015). However, an impact of autism diagnosis and autistic traits on emotion recognition has not been seen across all of the previous studies, with some finding no significant effect (Rosset et al., 2008; Hubert, Wicker, Monfardini & Deruelle, 2009). Furthermore, in a large meta-analysis of 48 studies, the authors concluded the influence of autism on emotion recognition requires further exploration, as only a small effect size was identified when controlling for publication bias (Cohen's d = .400; Uljarevic & Hamilton, 2012).

It has been posited that co-occurring alexithymic traits may be responsible for the literature's inconsistent findings (Cook et al., 2013), as approximately 50% of individuals with autism have concurrent alexithymia (Hill et al., 2004). In addition, alexithymia has been found to correlate highly with autistic traits in previous investigations ($r > .500$; Shah, Hall, Catmur & Bird, 2016). Considering this, recent studies have aimed to assess the individual contributions of both alexithymic and autistic traits on emotion recognition abilities. Interestingly, the majority of studies conclude alexithymia, not autism, is the main factor influencing emotion recognition difficulties (Cook et al., 2013; Milosavljevic et al., 2016;

Ketelaars, Mol, Swaab, & van Rijn, 2016). While one study concluded there was no main effect of alexithymia on emotion recognition in a sample of ASC adults (Heaton et al., 2012), it is possible this was due to the authors' use of auditory emotional stimuli, rather than emotional facial expressions.

Despite these promising findings, the majority of the previous literature has been conducted within adult samples. Therefore, it remains unclear to what extent autistic traits influence emotion recognition in typically developing preadolescent children. Furthermore, to what degree underlying alexithymia explains the potential relationship between autistic traits and emotion recognition deficits has yet to be investigated in a child sample.

7.1.2. *The Influence of Internalising/Externalising Behaviours on Emotion Recognition Abilities*

A consistent trend in previous literature investigating the correlates of child psychopathology has been the administration of the multi-informant parent-rated assessment tool, the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The SDQ has been used across clinical (Goodman, Renfrew & Mullick, 2000) and nonclinical (Goodman, Lamping & Ploubidis, 2010) child samples in order to detect symptoms of mental ill-health, notably adverse internalising and externalising behaviours. For example, significantly high ratings on the internalising problems scale (generated by combining the scores of the emotional symptoms and peer problems subfactors) has been found to be associated with the BAP (Tsai, Cebula & Fletcher-Watson, 2017), depressive/anxiety symptoms (Koskelainen, Sourander & Kaljonen, 2000) and peer victimisation (Zwierzynska, Wolke & Lereya, 2013) in children, and alexithymia in adolescents with autism spectrum conditions (Milosavljevic et al., 2016). In addition, children with Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder (O'Kearney, Salmon, Liwag, Fortune & Dawel, 2017) and bullying

tendencies (Kelly et al., 2015) have been found to score significantly higher on the externalising problems scale (generated by combining the scores of the conduct problems and inattention-hyperactivity subfactors). However, the majority of these studies have relied on questionnaire-based methodologies. Only a minority have investigated the behavioural correlates of internalising and externalising behaviours, with equivocal results. In one study conducted by Chronaki and colleagues (2015), young children at risk of behavioural problems were required to correctly identify emotions from vocal and visual emotive cues. The authors concluded externalising behavioural symptoms to be more associated with global emotion recognition deficits, whereas internalising behavioural difficulties had no significant effect. In contrast, Capistrano, Bianco and Kim (2016) found a significant mediating role of internalising behaviours (measured as a proxy for depressive and anxiety symptoms) in the relationship between low family socioeconomic status and emotional response inhibition. Similar to the speculation made by Cook and colleagues (2013), it is possible these varied findings may be due to underlying alexithymic traits within the tested samples. However, to date, a measure of alexithymia has yet to be co-administered with the SDQ during behavioural tasks. As such, it remains unclear if the effects of internalising/externalising behaviours on emotion recognition skills remain after correcting for alexithymic traits.

7.1.3. *Methodological Limitations of Previous Studies*

Similar to the limitations of the previous literature outlined in Chapter 3 Section 3.1, the majority of previous studies investigating the influence of child psychopathological symptoms on emotion recognition have predominately used labelling tasks in their methodologies. In these tasks, participants are presented with static images of posed emotional facial expressions and are required to identify which emotion they believe is being expressed. While these methodologies have been successful in identifying emotion recognition deficits in individuals with marked psychopathology, labelling tasks are often

subject to ceiling effects even in young populations (Thomas et al., 2007). Therefore, it may be speculated labelling tasks would fail to detect subtle emotion recognition deficits in children with subclinical levels of alexithymic, autistic, depressive and/or anxiety symptoms.

In child populations, the EEMT has been successfully used to identify an increased sensitivity towards sad faces in children at risk of depressive illness (Lopez-Duran, Kuhlman, George & Kovacs, 2013), a delayed identification of sad and fearful faces in children with psychopathic tendencies (Blair et al., 2001), a delayed identification of fearful faces in children with Down syndrome (Cebula, Wishart, Willis & Pitcairn, 2017) and a global decreased sensitivity towards emotional expressions in a child sample with ASC (Wallace et al., 2011). Despite this, the EEMT has been seldom administered to children with subclinical depressive/anxiety symptoms, autistic traits and/or alexithymia. In one study, typically developing children with high ratings of social anxiety were found to be less sensitive to angry emotions (Battaglia et al., 2010), contrary to investigations in clinical child populations (McClure et al., 2007; Waters, et al., 2010; Salum et al., 2017). However, Battaglia's study (2010) is not without significant limitations. In the authors' adaptation of the EEMT, the effect of social anxiety on sadness recognition was not assessed and only two emotional morphs per emotion category were administered, possibly reducing the applicability of the study's findings. Furthermore, only peer-report measures of child anxiety were administered and subclinical depressive/alexithymic symptoms were not assessed. Therefore, further investigation into the potential influence of subclinical child psychopathology on emotion recognition is required, particularly using dynamic emotional paradigms.

7.1.4. *The Current Study*

On reviewing the previous literature, it is clear there are numerous areas that require clarification and investigation. Therefore, the current study has the following aims. Firstly, to

investigate if cognitive biases towards emotional expressions can be identified using a newly developed child version of EEMT in a sample of preadolescent neurotypical children. Secondly, to investigate the effect of depressive, anxiety, autistic, adverse behavioural and alexithymic symptoms on emotion recognition, and to assess which of these psychological phenomena have the most significant influence on task performance. Lastly, to identify which of the AQC/AQC-P subfactor(s) explain significant variance in EEMT performance.

7.2. Method

7.2.1. *Participants*

296 families with children aged 8 to 13 were invited to take part in the current study using a participant database from the Edinburgh University Psychology Department. A study invitation email was sent to all families, with 57 responding showing interest in participating in the experiment. Families were reimbursed £15 for participating. Exclusion criteria included a formal diagnosis of a significant developmental disorder and an intelligence quotient out-with the lower limit of the normal range (IQ <70). Five children had a formal diagnosis of ASC and were therefore excluded from the main analysis. A further five children had dyslexia and two had dyspraxia, however this was not a concern to the researchers and these participants were included in the data analysis. One child was outwith the tested age range and an additional child did not complete the experimental task. Their data were therefore removed from the dataset and not included in the analysis. This gave a final sample size of 50 consisting of 26 boys and 24 girls, with a mean age of 9.46 (SD = 1.31).

7.2.2. *Measures*

A full overview of the Alexithymia Questionnaire for Children (AQC), Alexithymia Questionnaire for Children – Parent (AQC-P), Strengths and Difficulties Questionnaire (SDQ) and Depression Self Rated Scale (DSRS) can be seen in Chapter 5, Section 5.2.2.

7.2.2.1. Child measures

7.2.2.1.1. *Wechsler Abbreviated Scale of Intelligence (WASI)*

Intelligence was measured using the WASI (Wechsler, 1999) two-subtest estimate (FSIQ-2), containing the vocabulary and matrix reasoning subtests. The vocabulary subtest required the participants to describe and define words, such as 'entertainment' and 'haste'. The matrix reasoning subtest presented participants with coloured drawings following a pattern, with one cell missing. Participants were asked to identify which of the five options would follow the pattern presented in the matrix. Completion time of the FSIQ-2 took approximately twelve minutes. Raw scores were converted to *t* scores and an overall estimated IQ score was computed.

7.2.2.1.2. *Screen for Child Anxiety Related Emotional Disorders - Child (SCARED -C)*

The SCARED-C (Birmaher et al., 1997) is a 41-item self-report measure used to assess the severity of DSM-IV classified anxiety disorders, including social phobia, school phobia, panic disorder and separation anxiety disorder in children 8 to 18 years old (e.g., "when I am frightened, I feel dizzy"). The SCARED-C has been found to have high internal consistency ($\alpha > .800$; Su, Wang, Fan, Su & Gao, 2008) and good discriminant validity between anxious and non-anxious children (Birmaher et al., 1999). The measure is rated on a 3-point Likert scale (0 = "Almost Never" to 2 = "Often") with scores ranging from 0 to 82. Higher scores are indicative of more severe anxiety symptoms. Completion of the SCARED-C took approximately eight minutes. A cut-off score of 25 has been found to have adequate sensitivity (.759) and specificity (.628) to detect the possible presence of an anxiety disorder (Canals, Hernández-Martínez, Cosi & Domènech, 2012). Using this cut-off, it was found 31 (56%) had elevated anxiety symptoms, higher than expected of the general population (Su et al., 2008).

7.2.2.2. Parent measures

7.2.2.2.1. *Autism Spectrum Quotient for Children (AQ-C)*

The AQ-C (Auyeung, Baron-Cohen, Wheelwright & Allison, 2008) is a 50-item parent-reported measure used to assess the degree of autistic traits in children (e.g., "they frequently get so strongly absorbed in one thing that they lose sight of other things"). The scale has been found to have a good internal consistency (α >.900; Auyeung et al., 2008) and has been utilized across clinical (Weiss, Cappadocia, Tint & Pepler, 2015) and nonclinical (Ruzich et al., 2017) populations. Items are rated on a four-point Likert scale (0 = "Definitely Disagree" to 3 = "Definitely Agree"), with scores ranging from 0 to 150. Completion of the AQ-C took approximately ten minutes. Higher scores are indicative of more severe autistic traits. While a cut-off of 76 has been established to identify significantly heightened autistic traits (sensitivity = .950, specificity = .950; Auyeung et al., 2008), the current study will treat AQ-C scores as continuous, consistent with previous investigations (Rynkiewicz et al., 2016; Melling, Swinson & Brett, 2017).

7.2.2.3. Experimental task

7.2.2.3.1. *Emotional Expression Multimorph Task – Child (EEMT-C)*

An adapted version of the EEMT described in Chapter 3 was generated for use in preadolescent children. As the EEMT was part of a battery of tests, trials were reduced from 36 to 24 (4 morphs for each of the 6 emotional valences) in order to reduce study duration. Furthermore, morph frame presentation duration was doubled from 100ms to 200ms. This was done as preadolescent children have been found to have significantly slower emotional expression processing speed compared to adults (De Sonneville, 2002). The task was presented on a 15" laptop screen, approximately 60cm away from the participants. Lastly, in order to make the experimental task more appealing to the children, six emoticons (or,

"emojis") representing sadness, happiness, disgust, fear, anger and surprise were used in lieu of lexical responses (see Figure 7.1). Completion of the EEMT-C took approximately twelve minutes.

7.2.3. *Scoring the EEMT-C*

A detailed description of the method used to score the EEMT data can be seen in Chapter 3, Section 3.2.3.1. Accuracy scores were computed using two methods; an overall accuracy ('OA') and a first response accuracy ('FRA'). Average frame response ('AFR') scores were calculated by averaging the morph frame at which the participant correctly identified each of the four target emotions. If a participant did not correctly identify any of the emotional expressions in a particular emotional valence (e.g., disgust), no points were awarded for their accuracy scores and AFR scores were considered missing data. This is in accordance with the scoring system recommended by Berg and colleagues (2016).

7.2.4. *Procedure*

On entering the laboratory, children and parent(s) were informed again of the study's main objectives. After the parent(s) provided informed consent, children were brought into a quiet testing room free from distractions. First, the WASI was administered to the participants, taking approximately twelve minutes. On completing the WASI, participants were presented with the EEMT. Prior to the task's commencement, the six emoijis were shown to the children on an electronic information sheet. The child was asked to identify which emotion each emoji represented to the researchers. If a misidentification occurred, the researchers corrected the child's interpretation of the emoji and asked the child to demonstrate the emotional facial expression in order to confirm comprehension. The child was then informed they would watch 24 facial morphs, in which a neutral expression would slowly change into one of the six emotions. They were instructed to press the laptop's space

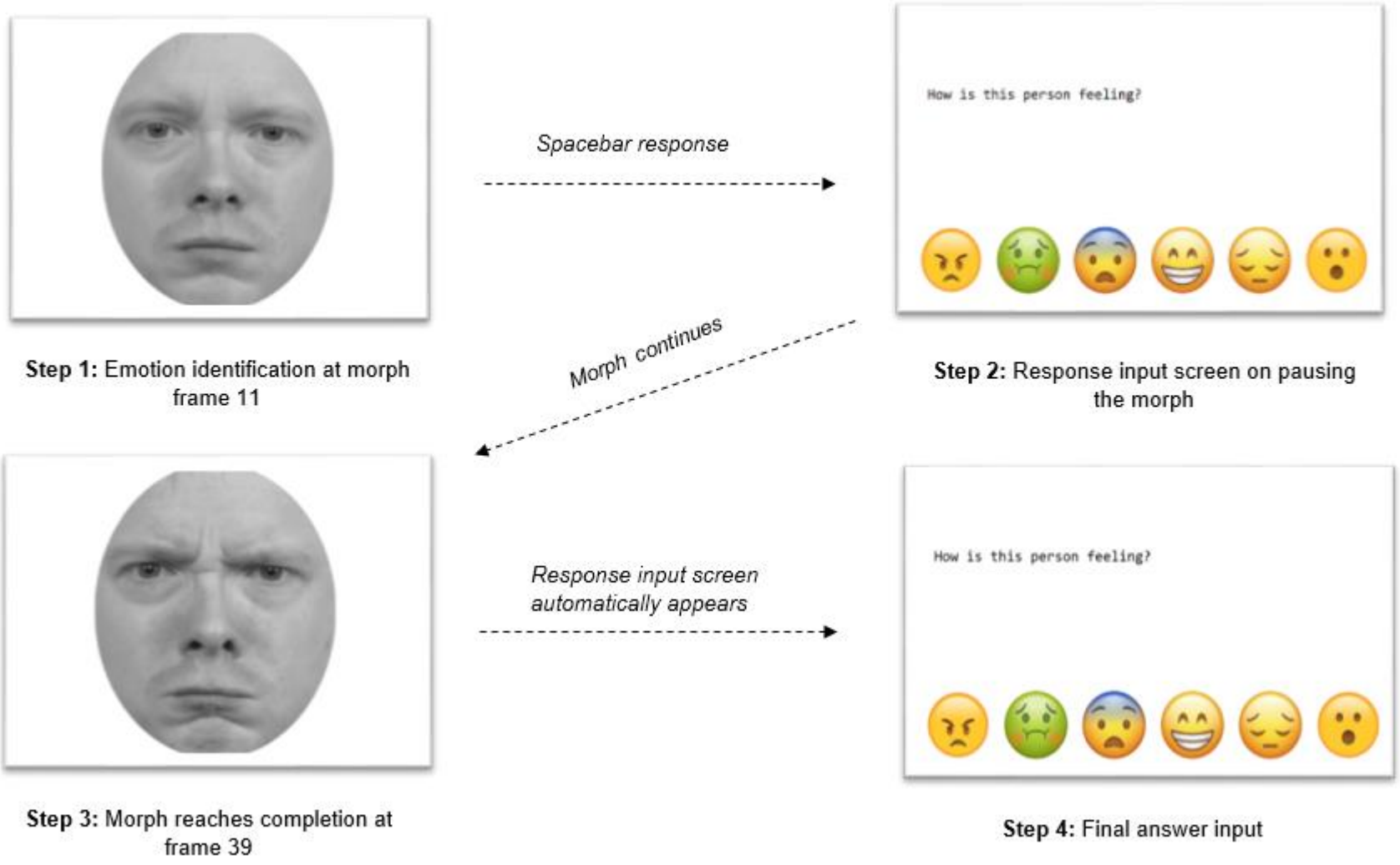

Figure 7.1. *Screenshots of the EEMT-C, demonstrating task procedure.*

bar as soon as they recognised which emotion the face was morphing into, without merely guessing. Three practice trials preceded the main experimental task. Participation in the experimental task took approximately twelve minutes. On completing the EEMT, children and parent(s) were then asked to complete the psychometric measures, presented in a questionnaire 'booklet' that took approximately fifteen minutes to complete (see Appendix 6 Sections A6.1 and A6.2). Participants were then debriefed on the experimental aims. Analysis was run on SPSS version 22 (SPSS, Chicago, IL, USA). The study obtained ethical approval from the University of Edinburgh Research Ethics Committee (210-1718/1).

7.2.5. *Statistical Analysis*

After confirming the normality of the data, any multivariate outliers were identified using Mahalanobis' distances. In order to investigate the relationships between the key variables and task performance scores, a correlational matrix was computed. After establishing significant effects of the key variables on EEMT performance, a multiple step-wise linear regression was run. This was done in order to identify the variables explaining significant degrees of variance on task performance scores. Potential confounding variables were controlled for in the regression model. Multicollinearity was assessed using a Durbin Watson statistic and variance inflation factors (VIFs) for each variable in the regression model. A Durbin Watson statistic between 1.50 and 2.50 and a VIF under 10 were considered acceptable (Farrar & Glauber, 1967).

7.3. Results I - The effect(s) of self-reported alexithymia, depressive symptoms and anxiety on EEMT performance

7.3.1. *Data Cleaning*

To assess missing data, an *a priori* missing data rule was applied for data cleaning. Participants with four or fewer missing data points per measure were retained in the analysis

and the average item score was inserted in order to generate total scores. If a participant left out more than four items, the total measure was not included in the analyses. Within the child participants, a total of fifteen had four or less missing data points; seven from the AQC, two from the DSRS and four from the SCARED-C. No children were found to leave out more than four items. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. In order to identify any significant multivariate outliers, Mahalanobis' distances were calculated with the alpha level set at $p < .001$. It was found none of the participants were above the critical value of 16.27 for the psychometric measures or 22.46 for the task performance scores. Therefore, none of the participants were excluded from the analysis.

7.3.2. *Descriptive Statistics*

The means, standard deviations and ranges of the measures are described in Table 7.1.

Table 7.1.

Means, standard deviations and ranges of key measures.

Measure	Mean	SD	Range
FSIQ-2	108.63	12.98	83 – 140
AQC	37.77	4.65	28 – 46
DSRS	9.23	4.04	2 – 17
SCARED-C	26.88	11.13	6 – 52

Note. FSIQ-2: Full Scale Intelligence Quotient – 2 Subscale, AQC: Alexithymia Questionnaire for Children, DSRS: Depression Self-Rated Scale, SCARED-C: Screen for Child Anxiety Related Emotional Disorders – Child.

7.3.3. *EEMT - Child Task Performance*

In order to assess the participants' performance on the EEMT-C, the average scores were calculated for the three experimental outcomes; OA, FRA and AFR (see Table 7.2).

Table 7.2.

Average performance on the Emotional Expression Multimorph Task – Child.

Emotion	Metric	Mean (%)	SD	Range (%)	OA/FRA Difference (t)
Anger	% OA	78.50	.756	50 – 100	-.773
	% FRA	75.50	.795	25 – 100	
	AFR	26.18	8.39	9.50 – 39	
Disgust	% OA	41.50	1.64	0 – 100	-.248
	% FRA	39.50	1.59	0 – 100	
	AFR	25.50	6.38	13 – 39	
Fear	% OA	61.50	1.09	0 – 100	-2.15*
	% FRA	50.00	1.05	0 – 100	
	AFR	28.33	6.30	15 – 39	
Happy	% OA	99.50	.141	75 – 100	-1.02
	% FRA	98.50	.239	75 – 100	
	AFR	15.91	5.13	6.50 -30	
Sad	% OA	76.50	1.11	0 – 100	-.893
	% FRA	71.50	1.12	0 – 100	
	AFR	29.26	4.51	20.50 – 39	
Surprised	% OA	71.00	1.17	0 – 100	-.340
	% FRA	69.00	1.18	0 – 100	
	AFR	25.87	6.06	15.50 – 37	
Overall	*% OA*	*71.90*	*2.63*	*42 – 92*	-2.02*
	% FRA	*67.33*	*2.81*	*42 – 92*	
	AFR	*102.58*	*27.49*	*102.50 – 151.42*	

Note. OA: Overall Accuracy, FRA: First Response Accuracy, AFR: Average Response Frame, SD: Standard deviation. *p<.05.

On average, the emotion most accurately identified was happiness, with 99.50% of overall responses and 98.50% first responses correct. Furthermore, happy faces were the quickest to be recognised, with an AFR score of 15.91 frames (approximately 3182 milliseconds) before correct identification. In contrast, disgust was the most inaccurately identified target emotion, with 41.50% of children correctly identifying the disgusted stimuli and 39.50% recognising it on their first response. As such, 31 children failed to correctly identify any of the disgusted facial emotions. Interestingly, sadness was the slowest emotion to be recognised, with an average response frame score of 29.26 (approximately 5852 milliseconds).

Regarding differences in overall and first response accuracy, a significant difference was found between the total scores ($t(98) = -2.02$, $p = .046$). Furthermore, children were significantly less likely to correctly identify fearful faces on their first response compared to their overall accuracy ($t(98) = -2.15$, $p = .034$). No other significant differences between overall and first response accuracy scores were identified.

7.3.4. *Relationships between the Key Experimental Variables and Task Performance*

In order to investigate the relationships between alexithymia, depressive symptoms and anxiety, a correlation matrix was computed. It was found alexithymia correlated significantly with both depressive symptoms ($r = .421$, $p = .002$) and anxiety ($r = .285$, $p = .042$). Furthermore, depressive symptoms and anxiety shared a significant correlation ($r = .610$, $p < .001$).

Regarding task accuracy scores, no significant correlations were identified between overall accuracy and alexithymia ($r = .024$, $p = .866$), depressive symptoms ($r = -.134$, $p = .352$) and anxiety ($r = .040$, $p = .781$). Furthermore, on inspection of the correlations between the key variables and total FRA score, no significant effect of alexithymia ($r = .024$, $p =$

.866), depressive symptoms (r = -.134, p = .352) or anxiety was identified (r = .040, p = .781). At the individual emotion level however, anxiety was found to correlate significantly with first response surprise score (r = .297, p = .036).

At the individual emotion response frame score, a significant effect of alexithymia (r = -.437, p = .002), depressive symptoms (r = -.448, p = .001) and anxiety (r = -.331, p = .020) were identified on the number of sad frames. No other significant effect was found on the other five target emotions.

7.3.5. *Identifying Potential Confounding Variables*

In order to identify any confounding variables in the later analysis, the potential effects of participant demographics (age, gender and intelligence) on alexithymia, depressive symptom, anxiety and task performance scores were investigated.

7.3.5.1. Participant gender

Independent sample t-tests revealed no significant effect of gender on alexithymia (t(48) = -.302, p = .764), depressive symptom (t(48) = -.485, p = .630) or anxiety (t(48) = -.708, p = .483) scores. Furthermore, gender did not significantly influence either of the two accuracy scores; OA (t(48) = -.245, p = .807) or FRA (t(48) = -.858), p = .395). However, on inspection of the AFR scores, females were significantly more sensitive towards sad faces than male participants (t(47) = 2.58, p = .013). No significant effect of gender was found on the other target emotions sensitivity scores.

7.3.5.2. Participant age

Participant age was found to correlate significantly negatively with self-reported alexithymia scores (r = -.421, p = .002). No significant correlations between age and depressive symptoms (r = -.242, p = .091) or anxiety (r = -.028, p = .847) were identified. At

the total EEMT accuracy scores, correlations between age and overall and first response accuracy scores approached significance (r = .249, p = .081; r= .267, p = .060, respectively). On inspection of the individual emotion accuracy scores, the significance was predominantly driven by disgust face accuracy (r = .293, p = .039). Furthermore, sensitivity scores for each of the target emotions found a near-significant relationship between participant age and the number of happy (r = .237, p = .097) and sad (r = .269, p = .061) AFR scores.

7.3.5.3. Participant intelligence

Lastly, intelligence was found to correlate non-significantly with alexithymia (r = -.034, p = .815), depressive symptoms (r = .116, p = .442) and anxiety (r = -.004, p =.977) scores. Intelligence was also found to share a non-significant relationships with all of the EEMT outcome variables.

7.3.6. *Multivariate Step-Wise Linear Regression*

The impact of alexithymia, depressive symptoms and anxiety on the sensitivity towards sad faces was assessed using multivariate step-wise linear regression analysis. Furthermore, as a significant association between total AQC score and sad response frame score was detected, it was of interest to ascertain which of the alexithymia construct(s) predicted significant variance in the regression model. Therefore, total AQC scores were parsed into the proposed subfactors, DIF, DDF and EOT. As a significant gender effect was identified on sad AFR scores, gender was inserted into the first step of the model using the enter method. Next, depressive symptom, DIF, DDF, EOT and anxiety scores were entered using the step-wise method. The regression model is shown in Table 7.3. Results from the regression found gender was a significant predictor of sad AFR scores, explaining 16.70% of the variance ($\Delta R^2 = .167$). On controlling for gender effects, both depressive symptoms and EOT significantly contributed to the predictive strength of the model, explaining 14.60% and

5.00% of the variance, respectively. DIF (β = -.096, p = .419), DDF (β = -.047, p = .730) and SCARED-C (β = -.063, p = .687) scores were found to predict a non-significant degree of variance in the regression model. The total regression model produced a Durbin Watson statistic of 2.11, suggesting there was little autocorrelation between the residuals (see Appendix 6 Section A6.3 for regression plots).

Table 7.3.

Hierarchical multivariate linear model of the effect of alexithymia, depressive symptoms and anxiety on sad response frame scores.

Step	Predictor Variables	Method	β	t	VIF	R^2	ΔR^2	*F*
1	Gender	Enter	-.313	-2.287*	1.035	.167	.167	4.621*
2	Gender	Enter	-.298	-2.365*	1.037	.267	.146	6.837**
	DSRS	Step-wise	-.394	-.3091**	1.067			
3	Gender	Enter	-.311	-2.555*	1.040	.317	.050	6.561***
	DSRS	Step-wise	-.296	-2.242*	1.266			
	EOT	Step-wise	-.291	-2.062*	1.401			

Note. DSRS: Depression Self Rated Scale, AQC: Alexithymia Questionnaire for Children, VIF: Variance Inflation Factor. *p <.05, **p <.01, ***p <.001

7.4. Results II: The effect of parent-rated alexithymia, autistic traits and behavioural strengths and weaknesses on EEMT performance

7.4.1. *Data Cleaning*

To assess missing data in the parent-reports, an *a priori* missing data rule was applied for data cleaning. Participants with four or fewer missing data points per measure were retained in the analyses and the average item score was inserted in order to generate total scores. If a participant left out more than four items, the total measure was not included in the analyses. Within the parents, a total of eleven had four or fewer missing data points; five

from the AQC-P, two from the SDQ and four from the AQ. As no parents were found to leave out more than four items, no participants were excluded from the dataset. Data were found to be normally distributed in the parent-rated measures. The normality of the key variable total score distributions was assessed using the method suggested by West and colleagues (1995) (see Chapter 2, Section 2.2.4 for full overview). On assessing the skewness and kurtosis values of the scores, it was found none of the key variables deviated significantly from normality. Lastly, in order to identify any significant multivariate outliers, Mahalanobis' distances were calculated with the alpha level set at $p < .001$. It was found none of the participants were above the critical value of 20.52 for the psychometric measures or 22.46 for the task performance scores. Therefore none of the participants were excluded from the analysis.

7.4.2. *Descriptive Statistics*

The means, standard deviations and ranges of the measures are described in Table 7.4.

Table 7.4.

Means, standard deviations and ranges of key variables.

Measure	Subscale	Mean	SD	Range
AQC-P		33.98	6.53	23 – 47
AQ-C		50.82	20.97	7 – 101
SDQ	Total difficulties	11.39	4.29	1 – 26
	Internalising behaviours	3.37	2.96	0 – 11
	Externalising behaviours	5.06	3.61	0 – 13
	Prosocability	7.96	2.20	3 – 10

Note. AQC-P, Alexithymia Questionnaire for Children – Parent, AQ: Autism-Spectrum Quotient, SDQ: Strengths and Difficulties Questionnaire.

7.4.3. *Distributions of Scores*

While the data will be treated as continuous variables, it was of interest to assess the distribution of scores. Similar to the AQC, currently there are no established cut-off scores for the AQC-P (Costa et al., 2017). However, it has been proposed a score of 17 and above on the total parent-rated SDQ is indicative of marked behavioural difficulties (Becker, Rothenberger & Sohn, 2015). Using this cut-off, it was found 8 children (16%) had marked behavioural difficulties. Furthermore, using a cut-off score of 76 for the AQ-C (Auyeung et al., 2008), it was found 8 children (16%) had elevated autistic traits.

7.4.4. *Relationships between the Key Experimental Variables and Task Performance Scores*

In order to assess the relationships between the key variables and task performance scores, correlational analyses were run. Between the key variables, parent-reported alexithymia correlated significantly with both autistic traits ($r = .618$, $p < .001$) and total behavioural difficulties ($r = .395$, $p = .005$). Furthermore, a significant relationship was identified between autistic traits and behavioural difficulties ($r = .487$, $p < .001$).

Regarding task accuracy performance, no significant correlations were identified between overall accuracy and parent-reported alexithymia ($r = -.132$, $p = .361$) autistic traits ($r = -.203$, $p = .157$), internalising behaviours ($r = -.255$, $p = .074$), externalising behaviours ($r = -.105$, $p = .468$) or prosocability ($r = .051$, $p = .724$). At the individual emotion level however, internalising behaviours correlated negatively with the number of correctly identified disgusted ($r = -.281$, $p = .048$) and fearful faces ($r = -.292$, $p = .039$).

Total FRA scores also failed to correlate with parent-reported alexithymia ($r = -.051$, $p = .723$), autistic traits ($r = .921$), internalising behaviours ($r = -.177$, $p = .220$), externalising behaviours ($r = -.092$, $p = .527$) and prosocability ($r = -.029$, $p = .844$).

On inspection of the individual AFR scores, it was found autistic traits were positively correlated with the number of fear ($r = .293$, $p = .021$) and happy frames ($r = .327$, $p = .021$). As no significant correlations were found with total AQC-P scores, the measure was parsed into its proposed subfactors. The AQC-P subfactors DIF and DDF correlated significantly with number of happy frames ($r = .288$, $p = .042$; $r = .346$, $p = .014$, respectively). Furthermore, DDF correlated significantly with disgust frames ($r = .424$, $p = .022$). The subfactor EOT did not correlate with any of the AFR scores. Within the SDQ, internalising behaviours were found to correlate significantly with happy frames ($r = .343$, $p = .015$). No other correlations were identified between the SDQ subfactors and AFR scores.

7.4.5. *Identifying Potential Confounding Variables*

In order to identify any confounding variables in the later analysis, the potential effects of participant demographics (age, gender and intelligence) on parent-reported alexithymia, autistic traits, internalising behaviours and task performance scores were investigated.

7.4.5.1. Participant gender

Independent sample t-tests revealed no significant gender effect on parent-rated alexithymia ($t(48) = 1.31$, $p = .197$), autistic traits ($t(48) = .434$, $p = .666$) or internalising behaviours ($t(48) = 1.21$, $p = .231$).

7.4.5.2. Participant age

No significant correlations between age and parent reported alexithymia ($r = .056$, $p = .700$), autistic traits ($r = -.089$, $p = .540$) or internalising behaviours ($r = .036$, $p = .803$) were identified.

7.4.5.3. Participant intelligence

Lastly, intelligence was found to correlate non-significantly with parent-reported alexithymia ($r = -.034$, $p = .815$), autistic traits ($r = .116$, $p = .442$) and internalising behaviours ($r = -.004$, $p = .977$) scores.

7.4.6. *Multivariate Step-Wise Linear Regression*

The degree of variance explained by the parent-reported alexithymia subfactors DIF, DDF and EOT, autistic traits and the SDQ subfactor internalising behaviours on the decreased sensitivity towards happy faces was assessed using multivariate linear regression analysis. As no significant effects of participant demographics on happy AFR scores emerged, the regression model was run without co-variates. The three key variables, parent-reported alexithymia, autistic traits and internalising behaviours were entered using the step-wise method. The regression model is shown in Table 7.5. The AQC-P subfactor DDF emerged as the only significant predictor of happy AFR score, explaining 11.90% of the variance ($R^2 = .119$). On entering the other variables into the regression model, neither DIF ($\beta = .166$, $p = .279$), EOT ($\beta = -.277$, $p = .077$) autistic traits ($\beta = .203$, $p = .203$) or internalising behaviours ($\beta = .242$, $p = .105$) predicted a significant degree of variance. The regression model produced a Durbin Watson statistic of 2.15, suggesting there was little autocorrelation between the residuals (see Appendix 6 Section A6.3 for regression plots).

Table 7.5.

Multivariate linear model of the effect of parent-rated alexithymia, autistic traits and internalising behaviour on happy response frame scores.

Step	Predictor Variables	Method	β	T	VIF	R^2	ΔR^2	F
1	AQC-P: DDF	Step-wise	.346	2.551*	1.000	.119	.119	6.506*

Note. AQC -P: Alexithymia Questionnaire for Children, DDF: Difficulty Describing Feelings, VIF: Variance Inflation Factor. *p <.05

7.4.7. *Summary of Results*

A summary of the results across the two analyses can be seen in Table 7.6.

7.5. Discussion

The influence of child psychopathology on emotion recognition has been well documented in past investigations, predominately in children with early-onset mood disorders (Collin, Bindra, Raju, Gillberg & Minnis, 2013), anxiety disorders (McClure et al., 2007) and autism spectrum conditions (Guastella et al., 2010). Despite promising findings in these clinical populations, the degree to which subclinical levels of psychopathology and alexithymic traits influence emotion recognition has yet to be investigated in children. Furthermore, a consistent limitation of the previous investigations has been the administration of labelling tasks. As these methodologies may fail to detect subtle emotional processing difficulties, previous authors have recommended using more cognitively demanding paradigms, such as the Emotional Expression Multimorph Task (EEMT; Blair et al., 2001). Therefore, the main aim of the current study was to assess the potential influence of subclinical depressive symptoms, anxiety, internalising behaviours, autistic traits and alexithymia on emotion recognition and processing abilities using the EEMT in a sample of healthy children.

Table 7.6.

Summary of the relationships between the key variables and EEMT task performance.

			Target emotion average frame response scores						
	Measure		Anger	Disgust	Fear	Happy	Sad	Surprise	*Total*
	AQC	*DIF*	.073	.028	.080	-.020	-.111	.180	.082
		DDF	.099	-.031	-.009	.068	-.363*	.254	-.016
Child		*EOT*	-.179	-.135	.043	.188	**-.373****	.062	.281
	DSRS		-.187	-.099	.041	.017	**-.448****	.036	.170
	SCARED –C		-.057	-.272	.014	.088	-.331*	-.011	-.161
	AQC-P	*DIF*	.049	.330	.062	.288*	.100	.073	.161
		DDF	.190	.424*	.111	**.346***	.142	.129	.199
Parent		*EOT*	-.087	.070	.008	.031	.130	-.225	-.200
	AQ-C		.213	.219	.293*	.343*	.187	.178	.247
	SDQ	*IB*	.082	.143	.243	343*	.093	.202	.218

Note. AQC: Alexithymia Questionnaire for Children, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, DSRS: Depression Self Rated Scale, SCARED-C: Screen for Child Anxiety Related Emotional Disorders, AQC-P Alexithymia Questionnaire for Children – Parent, AQ-C: Autism-Spectrum Quotient – Child, SDQ: Strengths and Difficulties Questionnaire, IB: Internalising Behaviours. Bold font denotes significant predictor in the regression analyses. *p <.05, **p <.01.

The first key finding was the significant, individual relationships between self-reported alexithymia, depressive symptoms and anxiety and the selective processing of sadness. That is, children with elevated psychopathological symptoms required significantly fewer morph frames to correctly identify sad faces. It appears that a cognitive bias towards negative stimuli can be observed even within healthy children, supporting the findings in healthy adult populations (Laeger et al., 2012). However, a heightened awareness towards threat was not identified in children with elevated anxiety symptoms, as the anxiety score did not significantly correlate with angry face sensitivity. It is possible that while cognitive biases elicited by depressive symptoms can be seen in healthy samples, a hypervigilance towards threatening stimuli may only be detected in children with clinical anxiety disorders, as seen in previous investigations (McClure et al., 2007).

Given the overlap in their symptomology it is unsurprising alexithymia, depressive and anxiety symptoms displayed similar effects on the EEMT, with all psychological constructs associating with increased sad face sensitivity. It could therefore be speculated all three variables may emerge as significant predictors of an increased sensitivity towards sadness. However, on inspection of the regression analysis once correcting for gender effects, depressive symptoms emerged as the largest significant predictor, explaining 14.60% of the variance. Consistent with the speculations made in Chapter 6, preadolescent children may lack the emotional competence to differentiate between affective alexithymic traits (i.e., DIF and DDF) and depressive symptoms, opting to rate themselves on global low mood. As such, DIF and DDF scores did not emerge as significant predictors in the regression analysis. In contrast, children are able to identify their cognitive alexithymic traits. In light of this, EOT scores emerged as a significant predictor of sad response frame score, explaining 6.10% of the variance.

Furthermore, anxiety symptoms did not explain significant variance in the regression model. Considering depressive and anxiety symptoms were highly correlated in the current sample (r = .609), both psychopathological symptoms are often highly comorbid, both in clinical and nonclinical child populations (Brady & Kendall, 1992; Cole et al., 1997). As such, the results from the regression analysis suggest anxiety's significant relationship with sad AFR score was fully explained by underlying depressive symptoms. Therefore, the findings from the first analysis suggest subclinical depressive symptoms are the most influential of the assessed psychopathological traits on emotional processing deficits in children. This is consistent with previous investigations in clinical adult populations (Morningstar et al., 2017; Demenescu et al., 2010).

In contrast, results from the second analysis found the parent-reported AQC-P subfactor, DDF, to be the only significant predictor of decreased sensitivity towards positive affect. Subclinical autistic traits however did not emerge as a significant predictor. This is in direct support of Cook and colleagues' previous investigations (2013), in which the authors concluded alexithymia, not autism, predicts poorer recognition of emotional facial expressions. Furthermore, internalising behaviours also did not emerge as significant predictors of happy response frame score. As the internalising behaviours subscale of the SDQ has been previously used as a proxy measure for depressive/anxiety symptoms (Capistrano et al., 2016) the lack of an association between this SDQ subscale and happy AFR score is consistent with findings in healthy adults, as found in Chapter 3. Despite this promising result, the study requires replication using a more direct parent-report measure of the child's depressive symptoms, such as the Child Behaviour Checklist Depression Scale (CBCL-D; Clarke, Lewinsohn, Hops & Seeley, 1992) in order to consolidate this finding.

The exclusive role of DDF identified in this empirical chapter adds support to the findings of Chapter 6, in which parent-rated DDF had a unique mediating role in the

relationship between emotion dysregulation and early-life depressive symptoms. As previously discussed in Chapter 6, it is possible parents may be unable to fully recognise their child's inabilities to *identify* their feelings, but may be aware of their difficulties in *articulating* their feelings. Supporting this notion, the subfactor DIF did not emerge as a significant predictor of happy AFR score. This is in contrast with the findings from Chapter 3, in which an exclusive role of DIF was found on happy response scores in adults. As such, it may therefore be concluded that while self-reporters can adequately report on DIF, parents rely on external behavioural cues to rate their child's alexithymic tendencies. As such, parent-rated DDF may act as a proxy measure for their child's difficulties identifying their emotions.

While parent-reported alexithymia, autistic traits and internalising behaviours correlated with happiness sensitivity, unique patterns of relationships emerged. Children with elevated autistic traits were also found to take significantly longer to identify fearful faces, in support of the findings within adult populations (Actis-Grosso et al., 2015). In addition, the parent-rated DDF shared a significant correlation with decreased disgust sensitivity, a similar finding that has been identified in some adult studies (Prkachin et al., 2009) but not all (Montebarocci, Surcinelli, Rossi, & Baldaro, 2011). It therefore appears that while a global deficit in happiness processing is seen across the psychopathological symptoms assessed, deficits in negative emotion processing varies.

Interestingly, no significant effects of any of the current study's key variables were found on global emotion recognition accuracy. It appears that child subclinical psychopathology, while having a significant influence on emotional *processing*, may not impact on overall emotion *recognition.* This is in partial support of Grynberg and colleagues (2012; see Chapter 3 for full overview), in which the authors speculated alexithymia is more associated with emotional processing, not recognition deficits. On inspection of the individual target emotions, happy faces were the quickest and most easily recognised by the

child participants, consistent with the vast majority of the previous literature (Gosselin et al., 1995). In contrast, disgusted faces were the least easily recognised, with less than half the sample correctly identifying any of the disgusted faces presented. Disgust has been suggested to be one of the last basic emotions for a child to correctly identify during their developmental trajectory, with children aged 11 and above reaching disgust accuracy on par with adult samples (Harms, Martin & Wallace, 2010). As such, a positive correlation was identified between age and disgust accuracy (r = .293). It therefore might be speculated the younger children in the study's sample were still undergoing brain development in the areas responsible for emotion recognition, most notably the amygdala (Adolphs, Tranel, Damasio & Damasio, 1994).

7.5.1. *Strengths*

The study has a number of strengths. It is the first to identify a bias towards sad expressions driven by depressive symptoms and externally oriented thinking in a sample of healthy children. Furthermore, it is the first to identify a significant influence of alexithymia on the attenuation away from positive affect, even when controlling for co-occurring autistic traits and internalising behaviours. Results from the current study therefore add to the notion that parents may be better placed to report on a child's apparent alexithymic traits, with the AQC-P subfactor DDF emerging as the main significant predictor of emotional processing deficits. Therefore, complementary parent-reports such as the AQC-P may be usefully administered in tandem with the self-rated AQC in order to gain a more complete understanding of the child's alexithymic tendencies. Secondly, floor effects were not seen in either the psychometric measures or the EEMT performance scores. It therefore appears subclinical psychopathological symptoms and emotional processing abilities fall on wide spectra, even within healthy, non-clinical child populations.

7.5.2. *Limitations*

The study also has limitations. As the study had a relatively conservative sample size of 50, replication is required in both clinical and nonclinical samples in order to consolidate the findings. Furthermore, as the study's sample was recruited via a participant database associated with the university, this may have caused bias in the participants tested. The study's sample produced higher rates of psychopathological symptoms that would have been expected from the general population (Su et al., 2008) with the average anxiety scores above the recommended cut-off of 25 (Canals et al., 2012). Additionally, in order to reduce study duration, the number of trials in the EEMT were reduced from six to four. In order to increase the reliability of the study's findings, the full version of the EEMT should be administered in future studies. Furthermore, as no cut-offs have been established for either the AQC or the AQC-P, group differences between those with high and low alexithymic traits could not be reliably ascertained using MANCOVAs in the study's analyses. Furthermore, the sample size made the use of MANCOVAs unfeasible. Lastly, any attention biases were not controlled for during the experimental procedure. However, it was stressed to the participants they could take breaks at any time during the study. Furthermore, the experimenter remained in the testing room with the participant and was able to intervene if the child became visibly uncomfortable or bored.

7.5.3. *Conclusion*

Similar to the previous chapter, the findings from the current study identified a complex relationship with child alexithymia and emotional expression processing. Considering children may lack the emotional introspection to adequately report on their affective alexithymia (i.e., DIF and DDF), both depressive symptoms and externally oriented thinking emerged as significant predictors of sad face sensitivity. In contrast, parent-rated

DDF emerged as the only significant predictor of happy face sensitivity. Therefore, the current study is the first to identify a significant contribution of early-life alexithymic traits on emotional expression processing deficits in a sample of healthy children. Furthermore, the findings from the current study add to the notion that the administration of both a self- and a parent-report may be a more appropriate approach to assess early-life alexithymic traits. However, as the study employed a relatively conservative sample size, replication in both clinical and nonclinical populations is required in order to confirm the findings.

Chapter 8

Summary of Results and General Conclusion

8.1. Introduction

Since Sifneos (1973) first coined the term ‘alexithymia’, a significant body of literature has been produced examining the potential causes and negative psychological and health consequences of marked alexithymic traits. While the previous studies have garnered promising results, much of this literature has been conducted in individuals with psychiatric illnesses. Consequently, it remains to be explored if similar patterns of associations emerge in nonclinical populations. The main purpose of this thesis was therefore to assess the antecedents and sequelae of alexithymia in individuals recruited from the general population. In this final chapter, the results of the empirical studies are summarised, the possible explanatory mechanisms for the thesis’ findings are discussed and potential directions for future studies and amelioration strategies are considered.

8.2. Recap of the Findings in Adults

Past literature assessing the causes and consequences of alexithymia have routinely had two overarching limitations. Alexithymia, depressive and anxiety symptoms are often highly intercorrelated (Honkalampi et al., 2000). As such, the first major limitation of the previous literature has been the infrequent co-administration of measures assessing all three psychological constructs concurrently in the tested samples. Secondly, it has been common practice for previous authors to use only the total TAS-20 scores in their analyses. By assessing the subfactors independently, their unique contributions can be assessed.

Considering the limitations of the previous empirical studies, this thesis ran a series of novel studies that examined (i) the mediating role of alexithymia in the relationship between childhood adversity and later-life depressive/anxiety symptoms (Chapter 2), (ii) if alexithymic traits remained a significant predictor of emotional expression processing deficits when controlling for potentially co-occurring depressive/anxiety symptoms (Chapter 3) and (iii) to what extent alexithymia is a distinct psychological construct from depressive/anxiety symptoms (Chapter 4).

It has been well established that experiences of traumatic events during childhood may predispose an individual to develop depressive and anxiety symptoms in their adulthood (Gibb et al., 2007). In addition, it has been speculated early-life adversity may be an antecedent of later-life alexithymic traits (Brown et al., 2016). However, much of the previous literature investigating the role of childhood adversity on later-life psychopathological symptoms has been conducted in clinical populations. Furthermore, potentially comorbid alexithymia has been seldom assessed in previous investigations. As such, the main aim of Chapter 2 was to ascertain if alexithymia had a mediating role on the known relationship between experiences of childhood trauma and depressive/anxiety symptoms in a sample from the general population. Results from the chapter highlighted an exclusive mediating role of the TAS-20 subfactor, DIF, in the relationship between psychological trauma (i.e., emotional abuse and neglect) and depressive/anxiety symptoms. After assessing a potential antecedent, it was next of interest to identify a potential consequence of alexithymia in individuals from the general population. To investigate this, a sample of nonclinical adults were asked to take part in an Emotional Expression Multimorph Task (EEMT; Blair et al., 2001) which involved participants watching neutral expressions gradually morph into emotionally salient expressions. As it may act as a proxy for emotional processing speed (Rosenberg et al., 2015), of particular interest was the participants'

sensitivity towards the emotional expressions. That is, how many morph iterations were required for them to correctly identify the emotion being portrayed. As both depression and anxiety are associated with biases towards specific emotional expressions, the main aim of Chapter 3 was to investigate if these were, at least in part, explained by underlying alexithymic traits. Similar to Chapter 2, results from Chapter 3 identified an exclusive role of DIF in the decreased sensitivity towards happy expressions. Considering the findings from Chapters 2 and 3, it was lastly of interest to ascertain if DIF was a psychological construct distinct from depressive and anxiety symptoms. In support of the previous literature in healthy adults (Loas et al., 2015), factor analyses conducted in Chapter 4 found this was the case. Additionally, DIF was found to be significantly more associated with psychopathological symptoms, which is in support of previous studies conducted in clinical populations (Grabe et al., 2004). In contrast, the composite DDF/EOT scores were more significantly associated with decreased empathic behaviour towards others. A summary of the findings in adults can be seen in Table 8.1. Taken together, the findings from the three empirical chapters in adults concluded that DIF may be the "core" concept of alexithymia and may exist as a proxy measure for poor interoceptive awareness, supporting the notion put forward by Murphy and colleagues (2017). This may act as an aggravating factor (dubbed the "p-factor") in the development and maintenance of other psychopathological symptoms (Caspi et al., 2014). Consequently, the investigation of alexithymia may produce insights into a wide range of psychiatric conditions.

8.3. Recap of the Findings in Children

To the author's knowledge, only 25 studies have examined alexithymia during childhood prior to the commencement of this body of research. While the vast majority of these previous studies have been conducted in paediatric clinical samples (e.g., Griffin et al., 2016), studies into alexithymia in healthy children were predominantly measure validation

Table 8.1.

Summary of the findings in adults.

Chapter	Main focus of study	N	Measures/Methodology used	Predictive TAS-20 Subfactor(s)	Main conclusion(s)
2	Examines role of alexithymia on the relationship between childhood adversity and depressive/anxiety symptoms.	371	**TAS-20, HADS, CTQ.** *Anonymous online questionnaire.* Age, gender + educational attainment controlled for	DIF	DIF partially mediates the relationship between childhood adversity, particularly psychological trauma, and later-life depressive/anxiety symptoms.
3	Assesses the role of alexithymia on the performance in an emotion recognition task (EEMT).	95	**TAS-20, BDI, STAI, EEMT.** *Laboratory experiment.* Age, gender + psychiatric illness diagnosis controlled for.	DIF	While significant main effects of alexithymia, depressive symptoms and trait anxiety on sensitivity towards happy expressions emerged, DIF score was the only significant predictor of happy AFR score.
4	Investigates if alexithymia is a distinct construct from depressive/anxiety symptoms. Furthermore, to assess the unique association(s) of the TAS-20 subfactors on the known correlates of global alexithymia.	231	**TAS-20, HADS, AQ, EQ, CTQ, PCL-C.** *Anonymous online questionnaire.*	N/A	DIF more associated with psychopathological symptoms. DDF/EOT composite score more associated with decreased empathic behaviour. DIF distinct psychological construct from depression/anxiety.

Note. TAS-20: Toronto Alexithymia Scale, DIF: Difficulty Identifying Feelings, DDF: Difficulty Describing Feelings, EOT: Externally Oriented Thinking, HADS: Hospital Depression Anxiety Scale, CTQ: Childhood Trauma Questionnaire, BDI: Becks Depression Inventory, STAI: State Trait Anxiety Inventory, EEMT: Emotional Expression Multimorph Task, AFR: Average Frame Response, AQ: Autism-Spectrum Quotient, EQ: Empathy Quotient, PCL-C: PTSD Civilian Checklist.

studies (e.g., Way et al., 2010). Consequently, little was known regarding the possible correlates and consequences of alexithymia in neurotypical preadolescent children. As a reliable parent-report of early-life alexithymia had yet to be identified, the first aim of this part of the thesis was to establish the congruent validity of a recently published measure, the AQC-P (Costa et al., 2017) in a sample of children and their parent(s). When compared to its self-reported counterpart, the AQC (Rieffe et al., 2006), both measures appeared to be equally valid in assessing a child's alexithymic traits. However, unique patterns of associations emerged. Fisher's r-to-z transformations revealed children's scores were significantly more related to the internal manifestations of alexithymia (i.e., depressive symptoms), whereas parent(s) scores were significantly more related to the external manifestations (e.g., decreased empathic and altruistic behaviour). It has been previously speculated that both alexithymia and depression are sequelae of maladaptive emotion regulation (Bagby et al., 1994; Gullone & Taffe, 2012). Considering this, it was next of interest to assess the potential mediating role of early-life alexithymia on the relationship between emotion dysregulation and depressive symptoms. Results from the chapter found a significant partial mediating role of the child-rated EOT in the relationship between expressive suppression and depressive symptoms. In contrast, a significant partial mediating role of the parent-rated DDF was observed in the relationship between cognitive reappraisal and depressive symptoms. In order to identify a potential behavioural correlate of early-life alexithymia, the emotional expression recognition task was replicated in a sample of children using a novel adaptation of the EEMT. Children with marked depressive symptoms were found to be more sensitive to negative affect (i.e., sad faces). However, in support of the findings from Chapter 6, parent-rated DDF was found to have an exclusive predicting role in decreased sensitivity towards positive affect (i.e, happy faces). A summary of the findings in children can be seen in Table 8.2.

Table 8.2.

Summary of the findings in children.

Chapter	Main focus of study	N	Measures/Methodology used	Predictive TAS-20 Subfactor(s)	Main conclusion(s)
5	Assesses the congruent validity of the AQC-P when compared to the AQC.	250	**AQC, AQC-P, DSRS, EQ, SDQ** *Questionnaire packs.*	N/A	AQC and AQC-P scores correlated significantly, both at the total score and the subfactor level. AQC scores more associated with internal struggles (i.e., depression). AQC-P scores more associated with external struggles (i.e., decreased empathy).
6	Examines the role of alexithymia on the relationship between emotion dysregulation and early-life depressive symptoms.	199	**AQC, AQC-P, DSRS, ERQ-CA.** *Questionnaire packs.* Developmental difficulties controlled for.	Parent: DDF Child: EOT	Child-rated EOT mediates relationship between ES and depressive symptoms. Parent-rated DDF mediates the relationship between CR and depressive symptoms.
7	Assesses the role of early-life alexithymia on the performance in an emotion recognition task (EEMT).	50	**AQC, AQC-P, DSRS, SCARED-C, AQ-C, SDQ.** *Laboratory experiment.* Participant gender controlled for.	Parent: DDF Child: EOT	Depressive symptoms and child-rated EOT emerged as significant predictors of sad AFR score, with depressive symptoms explaining the largest degree of variance. Parent-rated DDF emerged as the only significant predictor of happy AFR score.

Note. AQC: Alexithymia Questionnaire for Children, AQC-P: Alexithymia Questionnaire for Children – Parent, DSRS: Depression Self Rated Scale, EQ: Empathy Quotient, SDQ: Strengths and Difficulties Questionnaire, ERQ-CA: Emotion Regulation Questionnaire – Children and Adolescents, ES: Expressive Suppression; CR: Cognitive Reappraisal, AQ-C: Autism Spectrum Quotient – Child, SCARED –C: Screen for Child Anxiety Related Disorders – Child, EEMT: Emotion Expression Multimorph Task, AFR: Average Frame Response.

Taken together, findings from the empirical studies in children found early-life alexithymia is associated with both internal (e.g., depressive symptoms) and external (e.g., decreased empathy) difficulties. Furthermore, results from this body of research suggest children, while being able to correctly identify their *cognitive* alexithymic traits (i.e., EOT), may be unable to differentiate between their *affective* alexithymic traits (i.e., DIF and DDF) and depressive symptoms. In contrast, parents were better at identifying their child's observable affective alexithymic traits (i.e., DDF). It therefore may be speculated that observer-rated DDF may be a proxy measure of DIF in children.

8.4. The Neurobiological Basis of Alexithymia: the Role of Insular Cortex Abnormalities

While the biological mechanisms underpinning alexithymic traits remain incompletely understood, alexithymia is currently believed to be a consequence of malfunction in several shared neural networks (Han, Li, Mei, & Sun, 2018; Liemburg et al., 2012). One network which may be partially responsible for the development of alexithymia may be the salience network (Colic et al., 2016). The salience network (SN) has been proposed to be responsible for detecting and filtering pertinent emotional, bodily and interoceptive information (Seeley et al., 2007). The SN involves two key nodes; the anterior cingulate cortex (ACC) and the anterior insula (AI). The AI has been found to be involved in bodily homeostasis (Oppenheimer & Cechetto, 2016), emotional intelligence (Alkozei & Killgore, 2015), altruism (Chau, Zhong, Gordon, Krueger & Grafman, 2018) and self-awareness (Karnath & Baier, 2010). Considering the SN (particularly the AI) has been also found to play an integral role in interoceptive awareness (Critchley, Wiens, Rotshtein & Öhman & Dolan, 2004) it is unsurprising a growing body of evidence has suggested insular abnormalities may be an important neurological contributor towards alexithymic traits. For example, meta-analyses of previous neuroimaging studies have concluded alexithymia is

associated with both decreased insular grey matter volume (Xu, Opmeer, van Tol, Goerlich & Aleman, 2018) and activation (van der Velde et al., 2013). In addition, a recent study conducted by Chau and colleagues (2018) found the relationship between insula lesions and altruistic attitudes was significantly mediated by alexithymia, not empathic concern for others.

Consistent with the limitations of the previous studies using questionnaire- and behavioural task-based methodologies, the vast majority of the previous neuroimaging studies conducted have typically used only the total TAS-20 scores in the analyses. However, a minority of authors have identified a unique association between DIF and insula abnormalities. For example, DIF scores have been found to be exclusively associated with decreased grey matter volume in the AI (Zhang et al., 2011). Furthermore, damage to the insular cortex has also been found to be associated with acquired alexithymic traits in later-life, specifically DIF (Hogeveen, Bird, Chau, Kreuger & Grafman, 2016). This finding emerged even when co-occurring anterior cingulate cortex damage, depressive and anxiety symptoms were controlled for.

Results from this current body of research may add support to these previous studies. For example, Chapter 2 identified a significant mediating role of the DIF subfactor on the relationship between psychological trauma and later-life depressive and anxiety symptoms. Previous investigations have highlighted a link between experiences of childhood maltreatment and decreased grey matter volume (Perez et al., 2017) and altered connectivity (Teicher, Anderson, Ohashi & Polcari, 2014) in the insula.

Additionally, this thesis also found DIF to be significantly more associated with other symptoms of current psychopathology, specifically depressive, PTSD and anxiety symptoms. Furthermore, DIF was found to be a significant predictor of decreased sensitivity towards

positive affect, independent of co-occurring depressive and anxiety symptoms. Interestingly, previous works have identified significant, separate associations between insula and interoceptive awareness abnormalities in individuals with depression (Avery et al., 2014; Lackner & Fresco, 2016), PTSD (Meng et al., 2016; Lanius, Frewen, Tursich, Jetly & McKinnon, 2015) and GAD (Klumpp, Post, Angstadt, Fitzgerald & Phan, 2013; Lackner & Fresco, 2016). Additionally, when presented with happy expression stimuli, decreased activity in the insula has been observed in individuals with severe mood dysregulation (Tseng et al., 2016), ASC (Leung et al., 2015), and marked alexithymic traits (Lemche et al., 2013). Taken together, considering the findings from this current body of research and the studies discussed above, it appears that alexithymia (specifically DIF) and interoceptive awareness deficits may be sequelae of altered AI activity, connectivity and grey matter volume. It is possible these insular abnormalities are, at least in part, due to exposure to adverse environmental factors during childhood (McCrory et al., 2011; Hein & Monk, 2017). This in turn may act as a risk factor for the development of psychiatric conditions in later-life.

Results from previous neuroimaging studies conducted in preadolescent populations may also add support to this thesis's findings in children. There has been a growing interest in assessing if insular abnormalities may be responsible for atypical cognitive and social development. For example, recent studies have identified an association between decreased grey matter volume in the insula and maladaptive emotion regulation in children, both as a potential consequence of early-life trauma (McLaughlin, Peverill, Gold, Alves & Sheridan, 2015) and a risk-factor for developing depressive symptoms (Pagliaccio, Luby, Luking, Belden & Barch, 2014). Furthermore, significantly decreased insular activity in response to happy facial expression stimuli has been observed in children with ASC compared to healthy controls (Kim et al., 2015). Interestingly, Kim and colleagues (2015) did not assess potentially co-occurring alexithymic traits in their tested sample. As alexithymia has been

found to explain some of the psychosocial difficulties associated with ASC, both in adults (Bird et al., 2010) and children (Trevisan et al., 2016), it is possible Kim and colleagues' (2015) findings were underpinned by comorbid alexithymic traits, not an ASC diagnosis, in their tested sample. It may be that insular abnormalities are associated with early-life alexithymia, similar to the findings in adults (e.g., van der Velde et al., 2013). However, as the psychophysiology of early-life alexithymia has not been examined to date, this remains speculative.

8.5. A Case for Mindfulness: a Possible Amelioration Strategy for Alexithymia

Similar to the recent works aiming to identify alexithymia's neural correlates, there has been a growing interest in assessing the psychological benefits of mindfulness as an amelioration strategy in alexithymic individuals. Mindfulness, or mindfulness meditation, is a psychological concept of being attune to one's thoughts, feelings and bodily sensations in a non-judgemental manner (Kabat-Zinn, 2003). Rather than paying attention to the past or the future, subjects aim to focus on and accept the present physical and emotional experiences on a moment-to-moment basis (Kabat-Zinn, 2003). While mindfulness has a long history in ancient Buddhist traditions, mindfulness-based interventions (MBIs) have become an increasingly popular treatment strategy in Western psychotherapy (Salmon, Lush, Jabonski & Sephton, 2009). Typically, MBIs are eight- to sixteen-week long group-based therapies which include training in a broad range of psychological strategies encouraging openness, reappraising and acceptance (Kabat-Zinn, 2003). MBIs have been used successfully in the treatment of occupational-related stress (Kang et al., 2017), emotion dysregulation (Guendelman, Medeiros & Rampes, 2017), adverse psychological reactions to cancer diagnoses (Ledesma & Kumano, 2009) and has been found to significantly improve subjective psychological well-being in healthy individuals (Brown & Ryan, 2003). Furthermore, MBIs have been found to significantly improve the symptoms of psychiatric

conditions (Gu, Strauss, Bond & Cavanagh, 2015), such as trauma-related MDD (Williams et al., 2014), PTSD (Jasbi et al., 2018) and GAD (Hoge et al., 2013).

At the concept level, it has been suggested interoceptive awareness and mindfulness are highly analogous (Hölzel et al., 2011) as both require individuals to be attuned to their internal experiences (Hanley, Mehling & Garland, 2017). For instance, a key constituent of MBI's are 'body scanning' exercises, where clients are encouraged to focus on bodily sensations felt at the current moment (Ussher, Cropley, Playle, Mohidin & West, 2009). These body-oriented therapies have been suggested to support the identification and acceptance of internal signals (Hanley et al., 2017), in turn facilitating a deeper awareness of one's interoception. Consequently, there is a growing body of evidence to suggest MBI's increase interoceptive awareness. For example, studies have identified a significant improvement in interoception (e.g., via heartbeat detection and breath intake tasks) after mindfulness mediation sessions compared to controls (Parkin et al., 2014; Haase et al., 2014). Furthermore, questionnaire-based studies have identified a significant association between subjective interoceptive awareness and mindfulness, as measured by the Multidimensional Assessment of Interoceptive Awareness and Five Facet Mindfulness Questionnaire (Hanley et al., 2017).

As previously described in this thesis, it has been posited there is a significant overlap of interoceptive awareness deficits and alexithymic traits (Murphy et al., 2017). While there are currently no clear guidelines for treatment specifically targeting alexithymia, to date, four studies have been conducted investigating the usefulness of MBIs in the treatment of alexithymic individuals (Bornemann & Singer, 2017; Viding et al., 2015; Santarnecchi et al., 2014; Arias, Justo & Granados, 2010). For example, a recent study investigated the improvement of TAS-20 scores and performance in a heartbeat detection task after 3 months of group- and self-taught mindfulness training (Bornemann & Singer, 2017). It was found

TAS-20 scores, both at the total and subfactor level, significantly decreased after completion. In addition, interoceptive awareness was found to improve, with individuals significantly more accurate in the heartbeat detection task compared to baseline measurement. However, a recent meta-analyses of these four studies conducted by Norman, Marzano, Coulson & Oskis (2018) concluded that while the findings are promising, the effect sizes of the combined results were small to moderate. As such, a larger body of literature is required before decisive evidence emerges regarding the success of MBI treatment in alexithymic individuals.

While there is growing evidence mindfulness has benefits in the subjective wellbeing of both healthy (Brown & Ryan, 2003) and psychiatric (Gu et al., 2015) samples, recent works have suggested MBIs have long-term advantages at the neural level, particularly in the brain areas possibly responsible for interoception. In a sample of healthy adults, significantly improved connectivity in the right insular cortex was identified after participation in an 8-week long MBI (Sharp et al., 2018). Likewise, mindfulness training has been previously found to increase right insula grey matter volume (Santarnecchi et al., 2014). Interestingly, in a study conducted by Farb, Segal & Anderson (2012), improved performance in an interoceptive awareness task was observed in graduate students after mindfulness training. It was concluded this improvement may have been a result of increased insular activity and connectivity from baseline to follow-up measurement.

While the current literature is somewhat limited, the applicability of child-oriented MBIs has been recently investigated. Previous authors have focused predominantly on the benefits of mindfulness on cognitive, emotional and psychosocial development (Schonert-Reichl et al., 2015). For example, Flook and colleagues (2015) developed a school-based mindfulness training intervention, dubbed the ‘Kindness Curriculum’ (KC). The KC encouraged altruistic and empathic behaviour towards others, in turn aiming to increase the child’s utilisation of adaptive emotion regulation skills. After the 12-week intervention

period, the KC-group were found to have significant differences in teacher-assessed emotion regulation skills, compared to control children. In addition to emotion regulation strategies, previous authors have identified benefits of MBIs in psychological wellbeing (Crescentini et al., 2016) and metacognition (Vickery & Dorijee, 2016) in school populations. Furthermore, at the neural level, MBIs have also been found to increase activity in the insular cortex in a sample of older children at-risk of psychiatric illness (Strawn et al., 2016). Considering mindfulness has been found to improve emotion regulation skills in child populations, it is possible MBIs may significantly improve early-life alexithymic traits, in turn improving insular cortex connectivity and activity. However, to date, this has not been investigated.

Taken together, it appears mindfulness may be a potential amelioration strategy for both children and adults with marked alexithymic traits. Not only may MBIs have short-term benefits (e.g., increasing subjective psychological wellbeing), but may have long term benefits (e.g., targeting and adaptively altering the neural networks responsible for alexithymia, specifically the insular cortex). As such, it is possible alexithymic traits may be ameliorated by MBIs. However, considerable work is still required to confirm this.

8.6. Future Directions in Adults

8.6.1. *DIF-Specific Mindfulness Training*

As described in the previous section above, there are currently only four studies directly assessing the relationship between MBIs and alexithymic trait improvement. However, from the findings of this body of research, there may be some benefit in developing an "alexithymic-specific" MBI, with particular focus on an individual's difficulty in identifying their emotions. Considering a central goal of mindfulness training is increasing the individual's awareness of bodily and emotional signals (Kabat-Zinn, 2003), DIF-specific MBIs may encourage the identification, acceptance and reappraisal of one's feelings. By

addressing this during intervention, it is possible both the short-term (e.g., increased subjective wellbeing) and long-term (e.g., increased neutral network connectivity) benefits of mindfulness may be achieved in those with marked difficulties in identifying emotions.

8.6.2. *Interoceptive Awareness Treatments: Floatation-REST*

Similar to MBIs, there has been a growing interest in the benefits of intervention strategies specifically modulating interoceptive awareness and physiology (Khalsa et al., 2017). Recently, there have been calls for additional work investigating the benefits of Floatation-Reduced Environmental Stimulation Therapy ('Floatation-REST'; Feinstein et al., 2018). Floatation-REST refers to the one-hour procedure in which clients float in a shallow pool of water, dubbed an 'isolation tank'. To facilitate the feeling of being suspended, the water is body-temperature and saturated with magnesium sulphate. During the process, any external stimuli (e.g., visual, auditory and olfactory) in the client's perception are minimised to facilitate sensory deprivation. It has been speculated durations of sensory deprivation during Floatation-REST may enhance the awareness of interoceptive signals (Khalsa et al., 2017). While interest in the potential psychological benefits of isolation tanks is not new (Wexler, Mendelson, Leiderman & Solomon, 1958), their usefulness as a psychotherapeutic strategy has only recently been investigated. For example, a small sample of individuals with GAD and comorbid MDD (n = 44) were found to have significant short-term reductions in symptom severity after one hour-long Floatation-REST session (Feinstein et al., 2018). Furthermore, individuals with GAD who underwent 12-session long Floatation-REST treatments were found to have significant long-term improvement in their co-occurring depressive symptoms, interoception, sleep difficulties and maladaptive emotion regulation (Jonsson & Kjellgren, 2016). Therefore, while the findings are preliminary, there may be early evidence for Floatation-REST's beneficial short- and long-term antidepressant and anxiolytic effects. Furthermore, Flotation-REST may be a useful strategy to increase interoceptive awareness in those with both GAD

and/or MDD. Considering this, as alexithymia is associated with poor interoceptive awareness and frequently comorbid with depression and anxiety, it may be speculated alexithymic individuals may also benefit from such treatment strategies. However, to date, this has not been assessed and warrants investigation. Furthermore, it remains unknown if extended periods of Floatation-REST treatment improves neural connectivity, similar to MBIs. As such, longitudinal brain-imaging studies are required to examine this.

8.6.3. *The Psychophysiological Correlates of Alexithymia*

Considering the encouraging findings from previous questionnaire-based (e.g., Chapter 2 and 4) and behavioural task paradigms (Chapter 3) investigating the antecedents and sequelae of marked alexithymic traits, a possible next-step is to assess some of the psychophysiological correlates of alexithymia. In particular, there is growing speculation saccadic eye movement paradigms may be sensitive measures of underlying psychopathology and may be a useful assessment tool in the diagnosis of many psychiatric illnesses (Bittencourt et al, 2013). Saccadic eye movements (SEM) are rapid, subconscious ocular movements (Hallett, 1978) which facilitate the production of a high resolution mental image of the visual world, by directing the image(s) of interest onto the fovea (Bremmer, Kubischik, Hoffmann & Krekelberg, 2009).

SEMs are considered a useful cognitive parameter when investigating visual attention, which is known to be affected in numerous psychiatric illnesses (Hoffman & Subramaniam, 1995). As a result, SEM patterns are believed to be different in those with mental health disorders, when compared to healthy controls (for review, see Ainsworth and Garner, 2013). Within psychopathological research, abnormal SEM in psychiatric illnesses have been extensively investigated, particularly in MDD (Sweeney, Strojwas, Mann & Thase, 1998). Oculomotor tasks have previously proved useful assessments of MDD's psychophysiology,

as potential deficits in cognitive and motor control can be investigated (Winograd-Gurvich et al, 2006). Furthermore, SEM task performance may be influenced by motivational and emotional factors related to the attentional deficits associated with MDD (Jazbec et al, 2005). One of the most commonly used methods to investigate SEM is the pro- and anti-saccade task ('PAS'). Participants are required to fixate on a target, while an emotive stimulus is presented on either the left or the right of the fixation point. The participant would then be requested to look towards (pro-saccade) or away from (anti-saccade) the stimulus. A failure to inhibit a reflexive eye movement would be considered an error (Levy, Mendell & Holzman, 2004). A significant body of literature has been produced on the performance of MDD patients in PAS tasks, finding significantly higher error rates compared to healthy controls (Sweeney et al, 1998; Smyrnis et al., 2003; Harris, Reilly, Thase, Keshavan & Sweeney, 2009). However, to date, the influence of underlying alexithymia on PAS task performance has yet to be investigated. A recent investigation conducted by Gaigg, Cornell and Bird (2018) in a sample of alexithymic ASC adults versus alexithymic healthy adults found no significant group differences in skin conductance when presented with emotive images. In light of these findings, it would be of interest to explore if underlying alexithymia was responsible for SEM abnormalities, rather than MDD diagnosis. If alexithymia emerges as the underlying mechanism, PAS tasks may allow for a more objective measure of alexithymia. Future research is required to examine this.

8.7. Future Directions in Children

8.7.1. *Mindfulness Training in Children with Alexithymia*

As previously discussed in Section 8.5, the applicability of MBIs in children with marked alexithymic traits has yet to be investigated. Considering the promising, yet limited findings in adult populations, there may be speculation that mindfulness training can

potentially ameliorate early-life alexithymia. Furthermore, as interoceptive awareness deficits have been found in paediatric clinical samples (Schauder, Mash, Bryant & Cascio, 2015), it is possible similar interoceptive awareness problems may be identified in children with alexithymia, both in clinical and healthy populations. However, to date, the relationships between mindfulness, interoceptive awareness and early-life alexithymia have not been investigated. If significant associations are found, there may be advantages in developing child-appropriate MBIs to target childhood alexithymic traits. As previously discussed, results from this thesis concluded that parent-rated DDF may act as a proxy measure for DIF. While the results are tentative, DIF-specific MBIs may be also be beneficial for healthy children with marked alexithymic traits. Future research is required for the development of such early intervention strategies.

8.7.2. *Neuroimaging Studies in Children with Alexithymia*

Likewise, the neurobiological basis of early-life alexithymia has yet to be examined. As mentioned earlier in the chapter, investigations into paediatric populations with ASC (Kim et al., 2015) have identified significant brain activity and connectivity abnormalities, specifically in the insular cortex. It may therefore be speculated similar abnormalities may be identified in children with marked alexithymic traits. By identifying the neural networks responsible for early-life alexithymia, researchers can obtain a clearer understanding of alexithymia's psychophysiology during childhood. As such, future neural imaging studies are required to confirm these speculations.

8.7.3. *Longitudinal Studies in Children*

The vast majority of the previous literature investigating alexithymia in children have been conducted using cross-sectional samples. However, there may be some additional benefits of conducting epidemiological, longitudinal studies. That is, administering the

AQC/AQC-P to a cohort of families with preadolescent children and follow the potential change(s) in scores across a set period of time. Firstly, as it has not been previously assessed, a more clear understanding of alexithymia's developmental trajectory could be obtained. Secondly, if there are critical time period(s) (e.g., the transition from early- to late-preadolescence) in the development in alexithymic traits may be detected. Lastly, a wider scope of the external influencing factors on the development of alexithymia in childhood can be assessed.

8.8. Limitations of this Body of Research

8.8.1. *Sample Limitations in Adults*

The three empirical chapters conducted in adult samples shared a few limitations. Firstly, a significant proportion of the adults who participated in the studies were female. This may have had implications on the findings of this thesis, as some previous authors have identified significant gender differences in TAS-20 scores (Salminen et al., 1999). However, this thesis found no significant effect of gender, either at the total TAS-20 or subfactor level, supporting the works of Karukivi and colleagues (2010). Nevertheless, any significant gender effects on the other tested variables were controlled for during this thesis's analyses.

Secondly, participating adults were generally well-educated, with the majority of the tested samples holding a university degree (e.g., 82.70% of the adults recruited in Chapter 2). Previous large-scale studies in the general population have identified a significant inverse relationship with educational attainment and alexithymic trait severity (Salminen et al., 1999). However, more recent studies found no significant influence of educational attainment on TAS-20 score (Faramarzi & Khafri, 2017). In partial support of these findings, the current body of research identified a significant effect of educational attainment in Chapter 2, but not

in Chapter 4. As such, educational attainment was controlled for where appropriate in the analyses.

Lastly, while the age ranges across the three chapters were large (e.g., 18 to 72), the mean age of the participants was relatively young (e.g., Chapter 2 mean age = 32.43; Chapter 3, mean age = 27.71). Like educational attainment, the literature is inconsistent in regards to the effect of age on alexithymic traits. While some cross-sectional studies have found higher TAS-20 scores in older participants (Mattila et al., 2006), others have identified significantly higher TAS-20 scores in young adults (Moriguchi et al., 2007). Within this body of research, an inverse relationship between participant age and TAS-20 score was detected. That is, the younger the participant, the more marked their alexithymic traits were. Similar to gender and educational attainment, effects of participant age were controlled for during the thesis' analyses. Taken together, it appears the results obtained from this body of research are not due to peripheral factors, such as participant demographics.

8.8.2. *Sample Limitations in Children*

Limitations of the tested child samples may have also arisen. As this thesis aimed to assess the potential effect(s) of alexithymia in preadolescent children (8 to 13 year olds), it remains unclear if this thesis's findings could be extrapolated to younger populations (e.g., 5 to 7 year olds). However, considering these results suggest preadolescent children may be unable to differentiate between affective alexithymia and depressive symptoms, it may be speculated investigating even younger children may herald unreliable results, unless the AQC-P is administered in tandem. However, across the three chapters in child populations, no significant correlations between AQC/AQC-P score and age were found.

While care was taken to ensure a representative child population was recruited for study participation, biases may have arisen. In particular, the sample recruited for the

laboratory study (Chapter 7) was enrolled from a database of families interested in developmental psychology experiments based at the University of Edinburgh. Considering this, it may be speculated that the child and parent participants were particularly motivated to take part in the emotion recognition task. This may have resulted in a sample of children atypical of the general populace. However, on inspection of the data, it appeared none of the tested variables were subject to floor or ceiling effects.

8.8.3. *Methodological Limitations in Adults*

The studies in adult samples relied exclusively on self-reported measures of alexithymia. It has been previously speculated alexithymic individuals may lack the metacognition required to adequately report on their alexithymic traits. That is, they may be unaware of their emotional understanding difficulties. To possibly circumvent this issue, an adult-appropriate peer-rated measure of alexithymia such as the Observer Alexithymia Scale (Haviland et al., 2000) could have been administered in tandem with the TAS-20. However, previous studies have routinely found poor convergent validity between the two measures (Meganck, et al., 2010). Furthermore, due to the methodology used in Chapters 2 and 4, the administration of a peer-reported measure of alexithymia via an anonymous online questionnaire would not have proved possible.

8.8.4. *Methodological Limitations in Children*

As early-life psychological trauma was found to be a possible antecedent of alexithymia in Chapter 2, there may have been some benefit in administering a measure of trauma in the tested child samples such as the Trauma Symptom Checklist for Children (Briere, 1996). However, this would have brought some methodological and ethical issues. Firstly, preadolescent children themselves may lack the competence to recognise experiences of maltreatment, particularly emotional neglect (Newbury et al., 2018). Secondly, while

parent-reports of childhood trauma have been developed (Childhood Experience of Care and Abuse Interview; Bifulco, Brown, & Harris, 1994), caregivers may withhold information from the researchers, or be unaware of maltreatment from other family members (Fisher, Bunn, Jacobs, Moran & Bifulco, 2011). Lastly, administering a self-reported measure of maltreatment to children may induce psychological distress in the participants. Considering these limitations, the current body of research opted to measure childhood adversity retrospectively in the adult sample.

Secondly, it was anticipated the administration of the EEMT and batteries of psychometric measures to the child participants may have elicited boredom, lack of cooperation and/or poor comprehension of the tasks. However, in the samples tested, these difficulties were not apparent as the children were generally interested and motivated to participate.

Lastly, as discussed earlier, individuals with alexithymia may lack the metacognition to recognise their emotional understanding difficulties. As they may be unable to rate the full extent of their alexithymic traits in auto-evaluative measures, an observer-rated scale may fail to correlate with self-rated scores. In order to assess this, post-hoc analyses were conducted. Children's AQC scores were dichotomised around the median into "low alexithymia" (AQC score <35) and "high alexithymia" (AQC >35). Both the "low alexithymia" and "high alexithymia" groups correlated significantly with their matching AQC-P scores ($r = .235$, $p = .013$; $r = .239$, $p = .011$, respectively). The groups were found to be non-significantly different in correlations ($Z_{observed} = -.03$, $p = .936$). As such, it appears high AQC scoring children do not differ significantly from low scoring children in their ability to rate their alexithymic traits.

8.9. Concluding Remarks

The current body of research aimed to identify the antecedents and sequelae of alexithymia in children and adults from the general population. Using a series of novel investigations, results from the current thesis illuminated many of early- and later-life alexithymia's adverse psychological consequences. These are of particular concern as alexithymia's negative sequelae may have a lasting impact on an individual's mental health. However, while there remains much to be discovered regarding the treatment of alexithymic traits, there is emerging evidence regarding the benefits of MBIs. Results from this thesis suggest such intervention strategies should focus predominately on the individual's difficulties in identifying their emotions. Continued investigation into this may facilitate the development of DIF-specific MBIs that are applicable to children and adults. It is hoped the findings from the thesis' studies aid future research in the development of treatments that will provide both short- (e.g., increased subjective psychological wellbeing) and long- (e.g., decreased risk of psychiatric illness development and increased insular connectivity) term benefits to individuals with marked alexithymic traits.

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Appendices

Appendix 1 for Chapter 2.

A1.1. *Cut-off scores established for the CTQ traumata subfactors.*

Traumata subfactor	"None" cut-off score	"Low" cut-off score	"Moderate" cut-off score	"Severe" cut-off score
Emotional Abuse	5 – 8	9 – 12	13 - 15	16+
Emotional Neglect	5 – 9	10 – 14	15 - 17	18+
Physical Abuse	5 – 7	8 – 9	10 - 12	13+
Physical Neglect	5 – 7	8 – 9	10 - 12	13+
Sexual Abuse	5	6 – 7	8 - 12	13+

A1.2. *Qualtrics questionnaire (TAS-20, CTQ and HADS).*

Introduction: Hello, my name is Ruth Brown and I am a researcher at the University of Edinburgh. I am investigating the emotions and life experiences in adults. You are invited to take part in this anonymous questionnaire.

What is Involved: You will be provided statements about your emotions, previous childhood experiences, current experiences, mental well-being, empathy and behaviours in six separate sections. You will need to rate the extent to which you agree with them. The questionnaire has been approved by the Psychology Research Ethics Committee and will take approximately 20-25 minutes to complete.

Confidentiality: You may decide to stop taking part at any time without explanation. As some items in this questionnaire are sensitive in nature, you have the right to refuse to answer any question(s) that are being asked of you. You may also ask that any data you have supplied to be withdrawn and destroyed. We will not ask you to provide any personal information other than your age, gender and highest educational attainment. There will be an opportunity to leave your email address if you would like to take part in future studies in 2017/2018.

By consenting to take part in the study, you agree to the following:

1) I have read and understood the information above.

2) I understand that my answers in the study will be confidential and can leave question(s) blank if I do not want to answer them.

3) I understand I have the right to ask that any data I have supplied be withdrawn/destroyed.

☐ **I consent** ☐ **I do <u>not</u> consent**

Section 1: Your Emotions

Instructions: Please read these statements and rate the extent you agree/disagree with them. There are 20 items in this section.

		Completely Disagree	Disagree	Neutral	Agree	Completely Agree
1	I am often confused about what emotion I am feeling.					
2	It is difficult for me to find the right words for my feelings.					
3	I have physical sensations that even doctors don't understand.					
4	I am able to describe my feelings easily.					
5	I prefer to analyse my problems rather than just describe them.					
6	When I am upset, I don't know if I am sad, frightened or angry.					
7	I am often puzzled by sensations in my body.					
8	I prefer to just let things happen rather than to understand why they turned out that way.					
9	I have feelings that I can't quite identify.					
10	Being in touch with emotions is essential.					
11	I find it hard to describe how I feel about people.					
12	People tell me to describe my feelings more.					
13	I don't know what's going on inside me.					
14	I often don't know why I'm angry.					
15	I prefer talking to people about their daily activities rather than their feelings.					
16	I prefer to watch "light" entertainment shows rather than psychological dramas.					
17	It is difficult for me to reveal my innermost feelings, even to my close friends.					
18	I can feel close to someone even in moments of silence.					
19	I find examination of my feelings useful in solving personal problems.					
20	Looking for hidden meanings in movies or plays distracts from their enjoyment.					

Section 2: Your Childhood Experiences.

Instructions: For each item, think back to when you were growing up as a child. Please rate to what extent you agree with each item. There are 28 questions in this section. **Remember, if you do not wants to answer a particular item, please click the response "No Answer".**

		Never	Rarely	Sometimes	Often	Very Often	No Answer
1	I got hit so hard that I had to see a doctor or go to the hospital.						
2	People in my family felt close to each other.						
3	I knew there was someone to take care of me and protect me.						
4	People in my family said hurtful or insulting things to me.						
5	I believe I was sexually abused.						
6	Family hit me so hard that it left me with bruises and marks.						
7	I felt loved.						
8	People in my family called me, "stupid", "lazy", or "ugly".						
9	There was someone to take me to the doctor if I needed it.						
10	Someone molested me.						
11	Beaten so badly it was noticed by a teacher/neighbour/doctor.						
12	Someone in my family helped me feel important or special.						
13	I felt that someone in my family hated me.						
14	There was nothing I wanted to change about my family.						
15	I didn't have enough to eat.						
16	Someone tried to touch me in a sexual way/made me touch them.						
17	I was punished with a belt/board/cord/other hard object.						
18	People in my family looked out for each other.						
19	My childhood was perfect.						
20	I thought my parents wished I had never been born.						
21	My parents were too drunk or high to take care of the family.						
22	Someone tried to make me do/watch sexual things.						
23	I believe that I was physically abused.						

		Never	Rarely	Sometimes	Often	Very Often	No Answer
24	My family was a source of strength and support.						
25	I believe I was emotionally abused.						
26	My family was the best in the world.						
27	I had to wear dirty clothes.						
28	Someone threatened me unless I did something sexual.						

Section 3: Your Wellbeing

Instructions: Click the response that is closest to how you have been feeling in the past week. Don't take too long; your immediate answer is best. There are 14 questions in this section.

	I feel tense or "wound up".		I get a sort of frightened feeling as if something awful is about to happen.
3	Most of the time.	**3**	Very definitely and quite badly.
2	A lot of the time.	**2**	Yes, but not too badly.
1	From time to time; occasionally.	**1**	A little, but it doesn't worry me.
0	Not at all.	**0**	Not at all.

	I still enjoy the things I used to enjoy.		I can laugh and see the funny side of things.
0	Definitely as much.	**0**	As much as I ever could.
1	Not quite as much.	**1**	Not quite as much now.
2	Only a little.	**2**	Definitely not as much now.
3	Hardly at all.	**3**	Not at all.

	Worrying thoughts go through my mind.		I feel cheerful.
3	A great deal of the time.	**3**	Not at all.
2	A lot of the time.	**2**	Not often.
1	From time to time, but not too often.	**1**	Sometimes.
0	Only occasionally.	**0**	Most of the time.

	I can sit at ease and feel relaxed.		I feel as if I am slowed down.
0	Definitely,	**3**	Nearly all the time.
1	Usually.	**2**	Very often.
2	Not often.	**1**	Sometimes.
3	Not at all.	**0**	Not at all.

	I get a sort of frightened feeling, like "butterflies" in the stomach.		I've lost interest in my appearance.
0	Not at all.	**3**	Definitely.
1	Occasionally.	**2**	I don't take as much care as I should.
2	Quite often.	**1**	I may not take quite as much care.
3	Very often.	**0**	I take just as much care as ever.

	I feel restless; as if I have to be on the move.		I look forward with enjoyment to things.
3	Very much indeed.	**0**	As much as I ever did.
2	Quite a lot.	**1**	Rather less than I used to.
1	Not very much.	**2**	Definitely less than I used to.
0	Not at all.	**3**	Hardly at all.

	I get sudden feelings of panic.		I can enjoy a good book or radio or TV programme.
3	Very often indeed.	**0**	Often.
2	Quite often.	**1**	Sometimes.
1	Not very often.	**2**	Not often.
0	Not at all.	**3**	Very seldom.

Appendix 2 for Chapter 3.

A2.1. *Additional measures in the pre-experiment questionnaire (BDI and STAI).*

Many thanks for your help with this study! We would be grateful if you could complete the questions in this pack. The questions ask about your background, emotions, your wellbeing and your relationships.

How long will this take and how should this questionnaire pack be completed?

This part of the study will take approximately 20 minutes to complete. Only one answer should be ticked for each question. If there's anything you do not understand within this questionnaire pack, please ask one of the researchers to clarify what is being asked of you.

What if I don't want to answer anything that is asked of me?

You may decide you do not want to answer a particular question in this questionnaire pack. *You have the right to leave any questions blank without consequence.* Also, you may ask the researchers to withdraw any information you have provided and be for it to be deleted. Please remember your unique participant number that you can quote to the researchers.

Will this study be confidential?

Yes. The information we collect will only be seen by the research team, and will not be linked to any identifiable information you supply. The data collected may be presented at conferences and in future publications, however we will only present data with no personal identifying information.

SECTION I: ABOUT YOU

What is your age?: _____ What is today's date?: _____

What is your ethnicity? _____

What is your gender? (please tick): **MALE** ☐ **FEMALE** ☐ **OTHER** ☐

Are you currently undergoing any medical treatment? (please tick): **NO** ☐ **YES** ☐

If yes, please specify: _____

Have you been formally diagnosed with a psychiatric illness? (please tick): **NO** ☐ **YES** ☐

If yes, please specify: _____

If you have been formally diagnosed with a psychiatric illness, are you currently on medication for this?

(please tick): **NO** ☐ **YES** ☐

If yes, please specify: _____

SECTION III: YOUR MOOD

Please read each group of statements and circle the number beside the statement in each group that best describes the way you have been feeling during the **past two weeks, including today.** If more than one statement in the group seems to apply equally well, circle the highest number for that group.

CIRCLE	**Statement Group 1.**	CIRCLE	**Statement Group 6.**
0	I do not feel sad.	**0**	I don't feel like I am being punished.
1	I feel sad much of the time.	**1**	I feel I may be punished.
2	I am sad all the time.	**2**	I expect to be punished.
3	I am so sad or unhappy that I can't stand it.	**3**	I feel I am being punished.

CIRCLE	**Statement Group 2.**	CIRCLE	**Statement Group 7.**
0	I am not discouraged about my future.	**0**	I feel the same about myself as ever.
1	I feel more discouraged about my future than I used to be.	**1**	I have lost confidence in myself.
2	I do not expect things to work out for me.	**2**	I am disappointed in myself.
3	I feel my future is hopeless and will only get worse.	**3**	I dislike myself.

CIRCLE	**Statement Group 3.**	CIRCLE	**Statement Group 8.**
0	I do not feel like a failure.	**0**	I don't criticize or blame myself more than usual.
1	I have failed more than I should have.	**1**	I am more critical of myself that I used to be.
2	As I look back, I see a lot of failures.	**2**	I criticise myself for all of my faults.
3	I feel I am a total failure as a person.	**3**	I blame myself for everything bad that happens.

CIRCLE	**Statement Group 4.**	CIRCLE	**Statement Group 9.**
0	I get as much pleasure as I ever did from the things I enjoy.	**0**	I don't have any thoughts of killing myself.
1	I don't enjoy things as much as I used to.	**1**	I have thoughts of killing myself, but I would not carry them out.
2	I get very little pleasure from the things I used to enjoy.	**2**	I would like to kill myself.
3	I can't get any pleasure from the things I used to enjoy.	**3**	I would kill myself if I had the chance.

CIRCLE	**Statement Group 5.**	CIRCLE	**Statement Group 10.**
0	I don't feel particularly guilty.	**0**	I don't cry more anymore than I used to.
1	I feel guilty over many things I have done or should have done.	**1**	I cry more than I used to.
2	I feel quite guilty most of the time.	**2**	I cry over every little thing.
3	I feel guilty all of the time.	**3**	I feel like crying, but I can't.

CIRCLE	**Statement Group 11.**	CIRCLE	**Statement Group 16.**
0	I am no more restless or wound up than usual.	**0**	I am no more irritable than usual.
1	I feel more restless or wound up than usual.	**1**	I am more irritable than usual.
2	I am so restless or agitated that it's hard to stay still.	**2**	I am much more irritable than usual.
3	I am so restless or agitated that I have to keep moving or doing something.	**3**	I am irritable all the time.

CIRCLE	**Statement Group 12.**	CIRCLE	**Statement Group 17.**
0	I have not lost interest in other people or activities.	**0**	I have not experienced changes in my sleeping pattern.
1	I am less interested in other people or things than before.	**1a** **1b**	I sleep somewhat more than usual. I sleep somewhat less than usual.
2	I have lost most of my interest in other people or things.	**2a** **2b**	I sleep a lot more than usual. I sleep a lot less than usual.
3	It's hard to get interested in anything.	**3a** **3b**	I sleep most of the day. I wake up 1-2 hours early and can't get back to sleep.

CIRCLE	**Statement Group 13.**	CIRCLE	**Statement Group 18.**
0	I make decisions about as well as ever.	**0**	I have not experienced any change in my appetite.
1	I find it more difficult to make decisions than usual.	**1a** **1b**	My appetite's somewhat less than usual. My appetite's somewhat more than usual.
2	I have much greater difficulty in making decisions than I used to.	**2a** **2b**	My appetite's much less than usual. My appetite's much more than usual
3	I have trouble making any decisions.	**3a** **3b**	I have no appetite at all. I crave food all the time.

CIRCLE	**Statement Group 14.**	CIRCLE	**Statement Group 19.**
0	I do not feel I am worthless.	**0**	I can concentrate as well as ever.
1	I don't consider myself as worthwhile and useful as I used to.	**1**	I can't concentrate as well as usual.
2	I feel more worthless as compared to other people.	**2**	It's hard to keep my mind on anything very long.
3	I feel utterly worthless.	**3**	I find I can't concentrate on anything.

CIRCLE	**Statement Group 15.**	CIRCLE	**Statement Group 20.**
0	I have as much energy as ever.	**0**	I am no more tired or fatigued than usual.
1	I have less energy than I used to have.	**1**	I get more tired or fatigued more easily than usual.
2	I don't have enough energy to do much.	**2**	I am too tired or fatigued to do a lot of the things I used to.
3	I don't have enough energy to do anything	**3**	I am too tired or fatigued to do most of the things I used to do.

CIRCLE	Statement Group 21.
0	I have not noticed any recent changes in my interest of sex.
1	I am less interested in sex than I used to be.
2	I am much less interested in sex now.
3	I have lost interest in sex completely.

SECTION IV: YOUR WELLBEING

PART 1 (20 Questions):

Please tick the appropriate response to indicate how you feel **right now,** that is, at **this moment.** There are no right or wrong answers; don't spend too much time on any one statement. Your immediate answer is best.

		Not At All	Somewhat	Moderately So	Very Much So
1	I feel calm.				
2	I feel secure.				
3	I am tense.				
4	I feel strained.				
5	I feel at ease.				
6	I feel upset.				
7	I am presently worrying over possible misfortunes.				
8	I feel satisfied.				
9	I feel frightened.				
10	I feel comfortable.				
11	I feel self-confident.				
12	I feel nervous.				
13	I am jittery.				
14	I feel indecisive.				
15	I am relaxed.				
16	I feel content.				
17	I am worried.				
18	I feel confused.				
19	I feel steady.				
20	I feel pleasant.				

PART 2 (20 Questions):

Please tick the appropriate response to indicate how you **generally feel.** There are no right or wrong answers; do not spend too much time on any one statement. Your immediate answer is the best.

		Not At All	Somewhat	Moderately So	Very Much So
1	I feel pleasant.				
2	I feel nervous and restless.				
3	I feel satisfied with myself.				

		Not At All	Somewhat	Moderately So	Very Much So
4	I wish I could be as happy as others seem to be				
5	I feel like a failure.				
6	I feel rested.				
7	I am “calm, cool and collected.”				
8	I feel that difficulties are piling up so that I cannot overcome them.				
9	I worry too much over something that really doesn’t matter.				
10	I am happy.				
11	I have disturbing thoughts.				
12	I lack self-confidence.				
13	I feel secure.				
14	I make decisions easily.				
15	I feel inadequate.				
16	I am content.				
17	Some unimportant thought runs through my mind and bothers me.				
18	I take disappointments so keenly that I can’t put them out of my mind.				
19	I am a steady person.				
20	I get in a state of tension or turmoil as I think over my recent concerns and interests.				

A2.2. *Additional EEMT emotional expression morphs.*

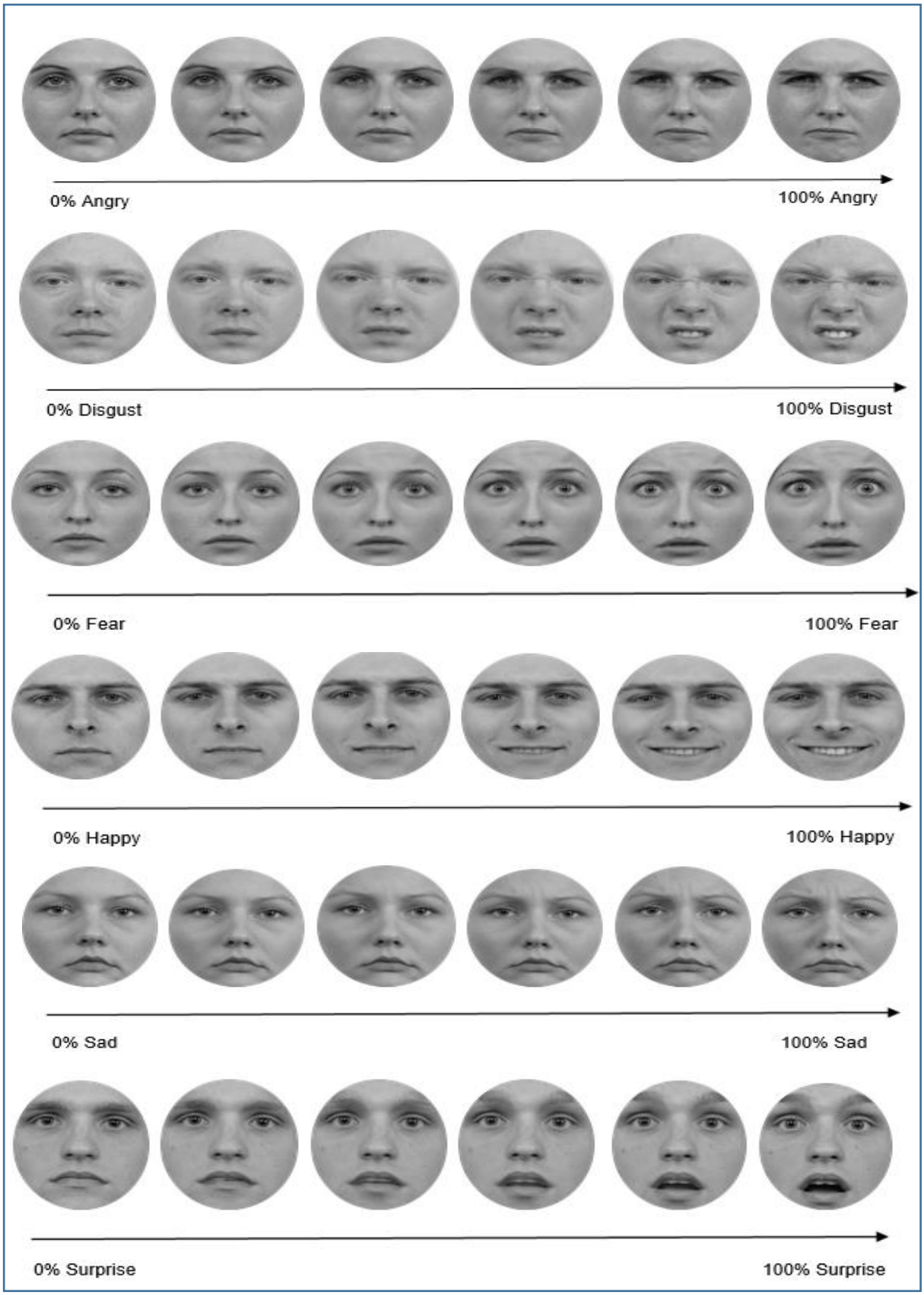

Figure A1. Examples of the EEMT emotional expression morph stimuli.

A2.3. Additional graphs from regression analysis in section 3.3.7.

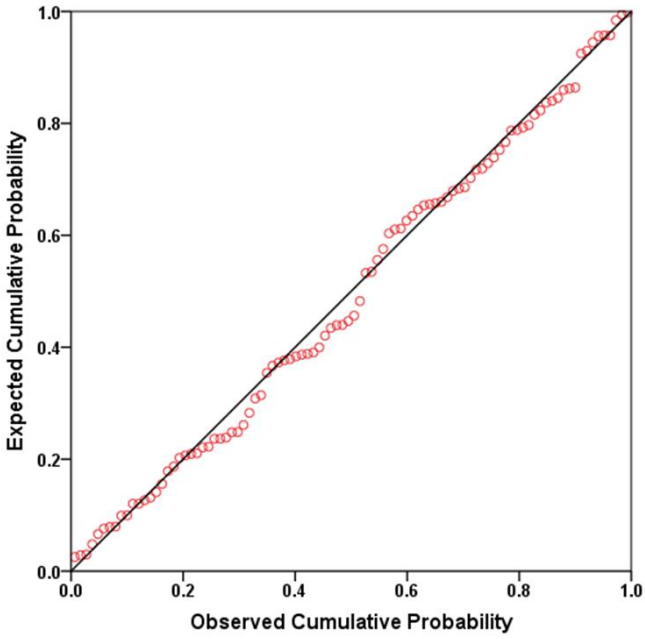

Figure A2.3.1 Normal P-P plot of regression standardized residuals, with Happy AFR scores as the dependant variable.

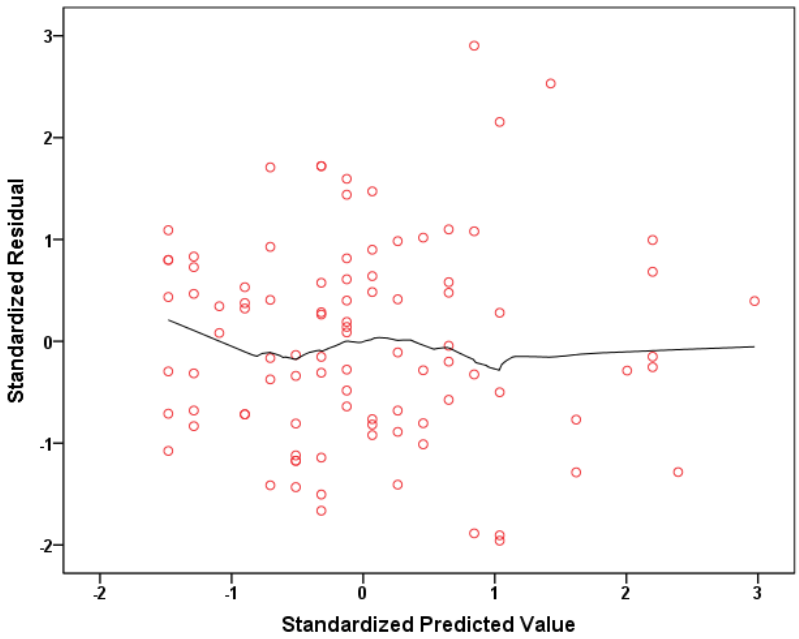

Figure A2.3.2 Scatterplot of standardised residuals and predicted values with Loess curve.

Appendix 3 for Chapter 4.

A3.1. *Additional measures in second wave of Qualtrics questionnaires (PCL-C, EQ and AQ).*

Section 4: Your Current Experiences

Please read through these statements and indicate how much you have been bothered by that problem **in the last month.** There are 17 questions in this section.

		Not At All	A Little Bit	Moderately	Quite a Bit	Extremely
1	Repeated, disturbing memories, thoughts or images of a stressful experience from the past?					
2	Repeated, disturbing dreams of a stressful experience from the past?					
3	Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?					
4	Feeling very upset when something reminded you of a stressful experience from the past?					
5	Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of a stressful experience from the past?					
6	Avoid thinking about or talking about a stressful experience from the past or avoid having feelings related to it?					
7	Avoid activities or situations because they remind you of a stressful experience from the past?					
8	Trouble remembering important parts of a stressful experience from the past?					
9	Lost interest in things you used to enjoy?					
10	Feeling distant or cut off from other people?					
11	Feeling emotionally numb or being unable to have loving feelings for those close to you?					
12	Feeling as if your future will somehow be cut-short?					
13	Trouble falling or staying asleep?					
14	Feeling irritable or having angry outbursts?					
15	Having difficulty concentrating?					
16	Being "super alert" or watchful on guard?					
17	Feeling jumpy or easily startled?					

Section 5: Your Empathy

Please read the statements and rate to what extent you agree with them. There are 22 items in this section.

		Definitely Disagree	Somewhat Disagree	Somewhat Agree	Definitely Agree
1	I can easily tell if someone else wants to enter a conversation.				
2	I really enjoy caring for other people.				
3	I find it hard to know what to do in a social situation.				
4	I often find it hard to judge if something is rude or polite.				
5	In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.				
6	I can pick up quickly if someone says one thing but means another.				
7	It is hard for me to see why some things upset people so much.				
8	I find it easy to put myself in somebody else's shoes.				
9	I am good at predicting how someone will feel.				
10	I am quick to spot when someone in a group is feeling awkward or uncomfortable.				
11	I can't always see why someone should have felt offended by a remark.				
12	I don't tend to find social situations confusing.				
13	Other people tell me I am good at understanding how they are feeling and what they are thinking.				
14	I can easily tell if someone else is interested or bored with what I am saying.				
15	Friends usually talk to me about their problems as they say that I am very understanding.				
16	I can sense if I am intruding, even if the other person doesn't tell me.				
17	Other people often say I am insensitive, though I don't always see why.				
18	I can tune into how someone else feels rapidly and intuitively.				
19	I can easily work out what another person might want to talk about.				
20	I can tell if someone is masking their true emotion.				
21	I am good at predicting what someone will do.				
22	I tend to get emotionally involved with a friend's problems.				

Section 6: Your Behaviours

This is the final section. Please read the statements and rate the extent you agree/disagree with them. There are 50 questions in this section.

		Definitely Disagree	Somewhat Disagree	Somewhat Agree	Definitely Agree
1	I prefer to do things with others rather than on my own.				
2	I prefer to do things the same way over and over again.				

		Definitely Disagree	Somewhat Disagree	Somewhat Agree	Definitely Agree
3	If I try to imagine something, I find it very easy to create a picture in my mind.				
4	I frequently get so strongly absorbed in one thing that I lose sight of other things.				
5	I often notice small sounds when others do not.				
6	I usually notice car number plates or similar strings of information.				
7	Other people frequently tell me that what I've said is impolite, even though I think it is polite.				
8	When I'm reading a story, I can easily imagine what the characters might look like.				
9	I am fascinated by dates.				
10	In a social group, I can easily keep track of several different people's conversations.				
11	I find social situations easy.				
12	I tend to notice details that others do not.				
13	I would rather go to a library than to a party.				
14	I find making up stories easy.				
15	I find myself drawn more strongly to people than to things.				
16	I tend to have very strong interests, which I get upset about if I can't pursue.				
17	I enjoy social chitchat.				
18	When I talk, it isn't always easy for others to get a word in edgewise.				
19	I am fascinated by numbers.				
20	When I'm reading a story, I find it difficult to work out the characters' intentions.				
21	I don't particularly enjoy reading fiction.				
22	I find it hard to make new friends.				
23	I notice patterns in things all the time.				
24	I would rather go to the theatre than a museum.				
25	It does not upset me if my daily routine is disturbed.				
26	I frequently find that I don't know how to keep a conversation going.				
27	I find it easy to "read between the lines" when someone is talking to me.				
28	I usually concentrate more on the whole picture, rather than on the small details.				
29	I am not very good at remembering phone numbers.				
30	I don't usually notice small changes in a situation or a person's appearance.				
31	I know how to tell if someone listening to me is getting bored.				
32	I find it easy to do more than one thing at once.				
33	When I talk on the phone, I'm not sure when it's my turn to speak.				
34	I enjoy doing things spontaneously.				

		Definitely Disagree	Somewhat Disagree	Somewhat Agree	Definitely Agree
35	I am often the last to understand the point of a joke.				
36	I find it easy to work out what someone is thinking or feeling just by looking at their face.				
37	If there is an interruption, I can switch back to what I was doing very quickly.				
38	I am good at social chitchat.				
39	People often tell me that I keep going on and on about the same thing.				
40	When I was young, I used to enjoy playing games involving pretending with other children.				
41	I like to collect information about categories of things (e.g., types of cars, birds, trains, plants).				
42	I find it difficult to imagine what it would be like to be someone else.				
43	I like to carefully plan any activities I participate in.				
44	I enjoy social occasions.				
45	I find it difficult to work out people's intentions.				
46	New situations make me anxious.				
47	I enjoy meeting new people.				
48	I am a good diplomat.				
49	I am not very good at remembering people's date of birth.				
50	I find it very easy to play games with children that involve pretending.				

A3.2. *Additional graphs from regression analysis in section 4.3.5.*

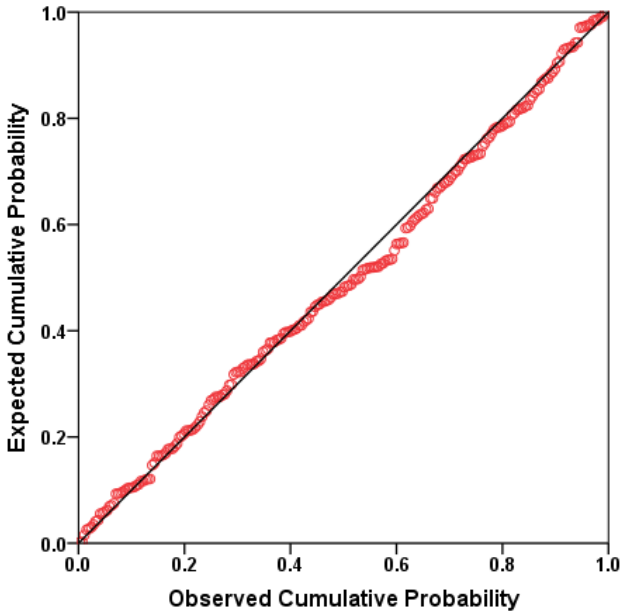

Figure A3.2.1 Normal P-P plot of regression standardized residuals, with DIF scores as the dependant variable.

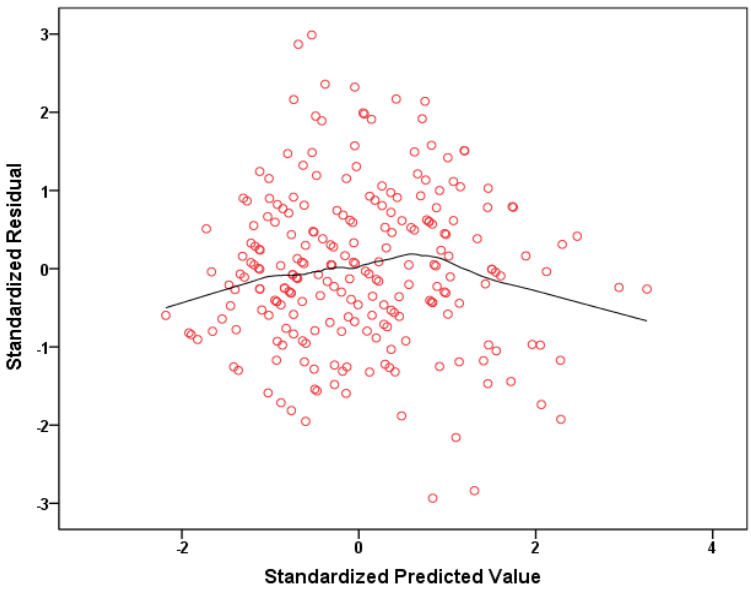

Figure A3.2.2 Scatterplot of standardised residuals and predicted values with Loess curve.

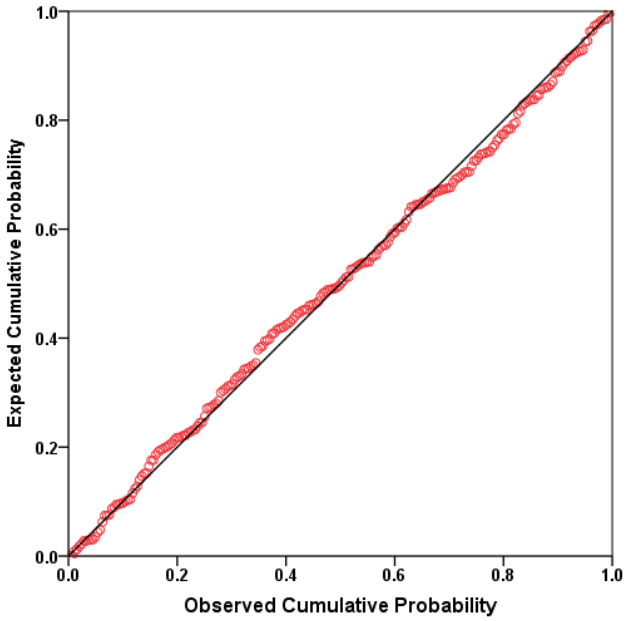

Figure A3.2.3 Normal P-P plot of regression standardized residuals, with DDF/EOT scores as the dependant variable.

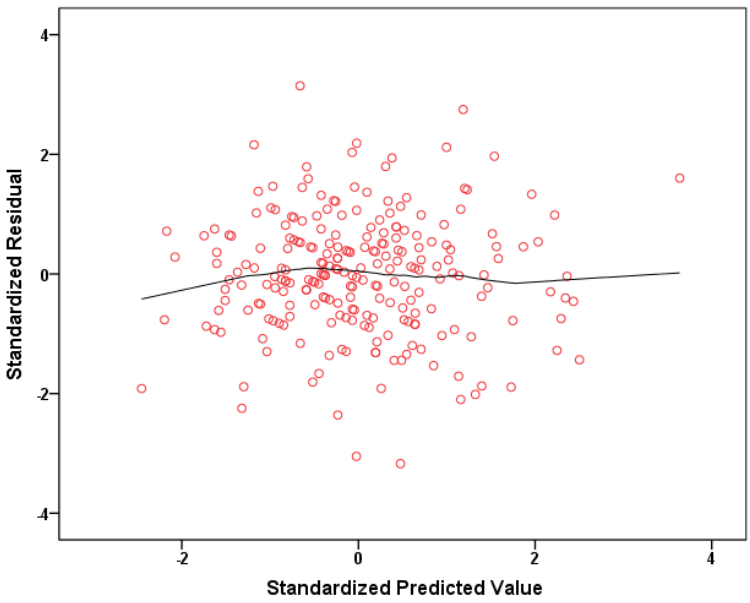

Figure A3.2.4 Scatterplot of standardised residuals and predicted values with Loess curve.

Appendix 4 for Chapter 5.

A4.1. *Child questionnaire booklet (AQC and DSRS).*

Child Pack Information Sheet

Hello! I'm Ruth and I'm a researcher at the University of Edinburgh. I'm interested in how children and young people understand their feelings … and you've been invited to take part in this questionnaire! We will ask you to answer some questions about the feelings you have. Before you decide if you want to join in, it's very important you read this booklet through carefully. We will ask your parent to complete some questions about you too.

Do I have to take part?

No, it is up to you if you would like to take part. If you do, we would like you to sign a form letting us know you are okay with answering the questionnaire.

What do I have to do?

I will ask you to complete this booklet. Feel free to ask your parent/guardian if you have any questions. You may also get in touch with me by email, at Ruth.Brown@ed.ac.uk.

How do I return my completed questionnaire?

Once both you and your parent/guardian have finished the questionnaires, please seal them in the envelope provided and bring them back to school. There will be a box in your classroom where you can drop off your finished questionnaires and I'll come collect them after the two week period.

Will anyone know what I've answered?

No. All the answers you give us will be kept in secret and we will not share your information with anyone. If you don't want to answer a particular question, it is okay to leave it blank.

Who has reviewed this study?

It is important that every study is checked by a Research Ethics Committee. They make sure the research is fair and safe to do. This study has been checked and approved by the University of Edinburgh Psychology Research Ethics Committee.

What if I don't want to take part anymore?

You can stop your taking part in this study at any point, for any reason.

If you're ready to take part, let's get started on the questionnaire!

We need to know a few things about you before you get started…

Are you a boy or a girl? (please circle) **BOY** **GIRL** What is today's date? _____

What is your date of birth? _____ What year of school are you in? _____

Here's the questionnaire. Tick the box that you think answers the question best for you. Some of the questions are similar to one another, but they are different in important ways. Please try and answer every question.

PART ONE

		Not True	Sometimes True	True
1	I am often confused about the way I feel inside.			
2	I find it difficult to say how I feel inside.			
3	I often don't know why I am angry.			
4	I can easily say how I feel inside.			
5	When I have a problem, I want to know where it comes from and not just talk about it.			
6	When I am upset, I don't know if I am sad, scared or angry.			
7	I am often puzzled by things that I feel in my body.			
8	I'd rather wait and see what happens, instead of thinking about why things happen.			
9	Sometimes I can't find the words to say how I feel inside.			
10	It is important to understand how you feel inside.			
11	I find it hard to say how I feel about other people.			
12	Other people tell me that I should talk more about how I feel inside.			
13	I don't know what's going on inside me.			
14	I feel things in my body that even I don't understand.			
15	I prefer talking to people about everyday things, rather than about how they feel.			
16	I prefer watching funny television programmes, rather than films that tell a story about other people's problems.			
17	It is difficult for me to say how I really feel inside, even to my best friend.			
18	I can feel close to someone, even when we are sitting still and not saying anything.			
19	Thinking about how I feel, helps me when I want to do something about my problems.			
20	When I have to concentrate on a film to understand the story, I enjoy the film much less.			

Well done! That's part one done. Let's move onto part two!

PART TWO

In this part, please read the sentences and tick the answer that best describes how you have felt in the past week. Remember to answer as honestly as you can.

		NEVER	SOMETIMES	MOSTLY
1	I look forward to things as much as I used to do.			
2	I sleep very well.			
3	I feel like crying.			
4	I like to go out to play.			
5	I feel like running away.			
6	I get tummy aches.			
7	I have lots of energy.			
8	I enjoy my food.			
9	I can stick up for myself.			
10	I think life isn't worth living.			
11	I am good at the things I do.			
12	I enjoy the things I do as much as I used to.			
13	I like talking with my family.			
14	I have bad dreams.			
15	I feel very lonely.			
16	I am easily cheered up.			
17	I feel so sad I can hardly stand it.			
18	I feel very bored.			

A4.2. *Parent questionnaire booklet (AQC-P, EQ and SDQ).*

THE UNIVERSITY OF EDINBURGH BEHAVIOUR AND EMOTIONS STUDY

Hello! I am a researcher who is investigating the emotional development of children. Both you and your child are being invited to take part. The study has obtained ethics approval from The University of Edinburgh. This booklet contains a study information sheet and a consent form.

WHAT IS THIS QUESTIONNAIRE ABOUT?

This questionnaire is about how children learn to understand their own emotions. The goals of this research are to provide assistance to young people and families as they navigate early teenage development. There are two questionnaires associated with this study; a Parent Pack and a Child Pack. Both contain similar questions, but should be answered separately. The questionnaire should take no more than 25 minutes to complete.

HOW SHOULD IT BE COMPLETED?

Only one answer should be ticked for each question. Please provide your first reaction to the question. It is intended that the Parent and Child sections are completed separately.

WILL THIS STUDY BE CONFIDENTIAL?

Yes. The information we collect will only be seen by the research team, and will not be linked to any identifying personal information that you or your child have supplied. You have the right to ask that any data supplied to be withdrawn/destroyed. The data collected will be presented at conferences and in academic publications, however we will only present data with no personal identifying information. Your child's individual data will not be presented in any data analysis.

IF I HAVE A QUERY, WHO CAN I CONTACT?

If you have any questions, feel free to contact either Ruth Brown or the research team's supervisor (Dr Bonnie Auyeung). You may contact Ruth at Ruth.Brown@ed.ac.uk or Bonnie at Bonnie.Auyeung@ed.ac.uk

PART 1: BACKGROUND

Child's Sex: ☐ Male ☐ Female Child's Date of birth (DD/MM/YY): _____

Today's date:_____ Child's Age:_____ years _____months

Your relationship to child (e.g., mother, father, caregiver): _____

Does your children have any siblings? ☐ No ☐ Yes (birth order eg. 1st of 2): _____

Is your child undergoing any medical treatment? ☐ No ☐ Yes: (please specify what treatment they are receiving: _____)

Does your child have any developmental problems/difficulties? ☐ No ☐ Yes (please specify: _____)

Is there anyone in your child's immediate family with any developmental/psychiatric conditions? ☐ No ☐ Yes (please specify: _____)

What is your occupation? _____

What is your current partner's occupation? _____

What is your highest academic qualification? _____

What is your partner's highest academic qualification? _____

PART 2: YOUR CHILD'S EMOTIONS

Please answer the following questions about your child by ticking the appropriate response.

		Not True	Sometimes True	True
1	My child is often confused about the way they feel inside.			
2	My child does not find it difficult to say how they feel inside.			

3	My child often doesn't know why they are angry.			
4	My child is able to describe their feelings easily.			
5	My child prefers to analyse their problems, rather than just describe them.			
6	My child doesn't know whether they are sad, frightened or angry.			
7	My child is often puzzled by sensations in their body.			
8	My child prefers to just let things happen rather than to understand why they turned out that way.			
9	My child has feelings that they can't quite identify.			
10	My child believes being in touch with their feelings is essential.			
11	My child finds it hard to describe how they feel about people.			
12	People tell my child to describe their feelings more.			
13	My child doesn't know what's going on inside of them.			
14	My child feels things in their body that even they don't understand.			
15	My child prefers to talk to people about their daily activities rather than their feelings.			
16	My child prefers to watch 'light' entertainment shows rather than psychological dramas.			
17	My child finds it difficult to reveal their innermost feelings, even to their close friends.			
18	My child finds examination of their feelings useful for solving their personal problems.			
19	My child finds examination of their feelings useful for solving their personal problems.			
20	My child believes looking for hidden meanings in movies or plays distracts from their enjoyment.			

PART 3: YOUR CHILD'S EMPATHY

Please answer the questions about your child by ticking the appropriate response.

		Definitely Disagree	Slightly Disagree	Slightly Agree	Definitely Agree
1	My child likes to look after other people.				
2	My child often doesn't understand why some things upset other people so much.				
3	My child would not cry or get upset if a character in a film died.				
4	My child is quick to notice when people are joking.				
5	My child has stolen something they wanted from their sibling or friend.				
6	My child has trouble forming friendships.				
7	When playing with other children, my child spontaneously takes turns and shares toys.				
8	My child can be blunt giving their opinions, even when these may upset someone.				
9	My child would enjoy looking after a pet.				
10	My child can be rude or impolite without realising it.				
11	My child has been in trouble for physical bullying.				
12	At school, when my child understands something they can easily explain it to others.				

13	My child has one or two close friends, as well as several other friends.				
14	My child listens to others' opinions, even when different from their own.				
15	My child shows concern when others are upset.				
16	My child can seem so preoccupied with their own thoughts that they don't notice others getting bored.				
17	My child blames other children for things that they themselves have done.				
18	My child gets very upset if they see an animal in pain.				
19	My child enjoys cutting up worms, or pulling the legs off insects.				
20	My child sometimes pushes or pinches someone if they are annoying them.				
21	My child can easily tell when another person wants to enter into conversation with them.				
22	My child is good at negotiating for what they want.				
23	My child would worry about how another child would feel if they weren't invited to a party.				
24	My child gets upset at seeing others crying or in pain.				
25	My child likes to help new children integrate in class.				
26	My child has been in trouble for name-calling or teasing.				
27	My child tends to resort to physical aggression to get what they want.				

PART 4: YOUR CHILD'S STRENGTHS AND DIFFICULTIES

Reflecting on your child's behaviour over the past six months, please tick the appropriate response

		Not True	Somewhat True	Certainly True
1	Considerate of other people's feelings.			
2	Restless, overactive, cannot stay still for long.			
3	Often complains of headaches, stomach-aches or sickness.			
4	Shares readily with other children (treats, toys, pencils etc.)			
5	Often has temper tantrums or hot tempers.			
6	Rather solitary, tends to play alone.			
7	Generally obedient, usually does what adult requests.			
8	Many worries, often seems worried.			
9	Helpful if someone is hurt, upset or feeling ill.			
10	Constantly fidgeting or squirming.			
11	Has at least one good friend.			
12	Often fights with other children or bullies them.			
13	Often unhappy, down-hearted or tearful.			
14	Generally liked by other children.			
15	Easily distracted, concentration wanders.			
16	Nervous or clingy in new situations, easily loses confidence.			
17	Kind to younger children.			
18	Often lies or cheats.			
19	Picked on or bullied by other children.			

20	Often volunteers to help others (parents, teachers, other children).			
21	Thinks things out before acting.			
22	Steals from home, school or elsewhere.			
23	Gets on better with adults than other children.			
24	Many fears, easily scared.			
25	Sees tasks through to the end, good attention span.			

.

Overall, do you think that your child has difficulties in one or more of the following areas: ***emotions, concentration, behaviour or being able to get on with other people? (please tick):***

No	Yes-minor difficulties	Yes-definite difficulties	Yes-severe difficulties
☐	☐	☐	☐

If answered "yes", please answer the following questions about these difficulties:

How long have these difficulties been present?

Less than a month	1-5 months	6-12 months	Over a year
☐	☐	☐	☐

Do the difficulties upset or distress your child?

Not at all	Only a little	Quite a lot	A great deal
☐	☐	☐	☐

A4.3 *Additional graphs from regression analysis in section 5.3.5.*

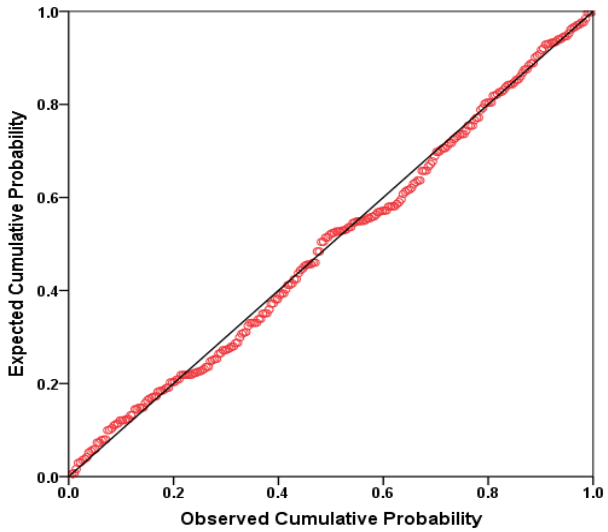

Figure A4.3.1. Normal P-P plot of regression standardized residuals, with AQC scores as the dependant variable.

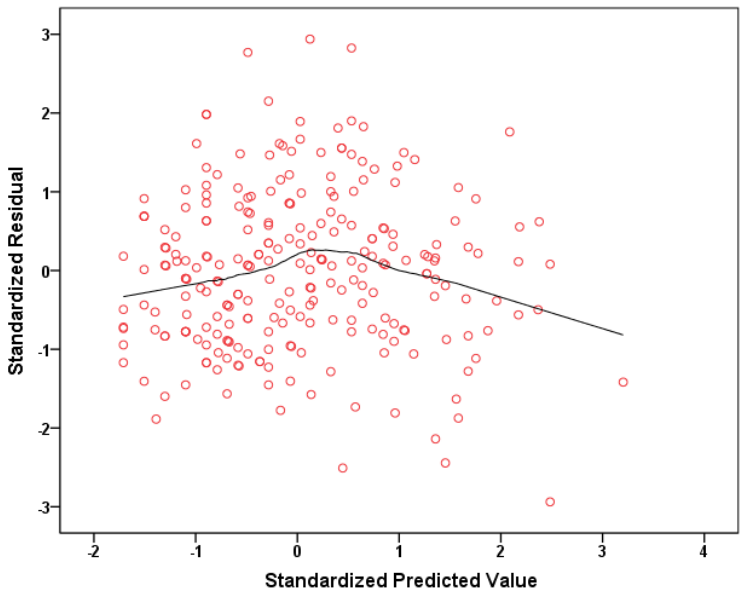

Figure A4.3.2. Scatterplot of standardised residuals and predicted values with Loess curve.

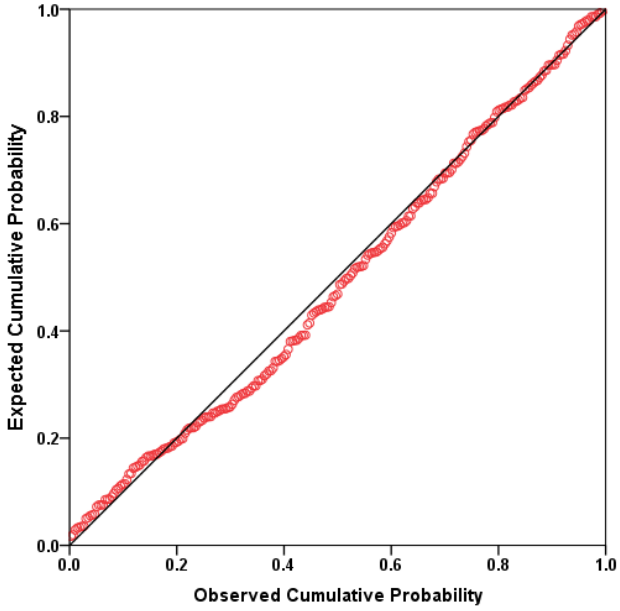

Figure A4.3.3. Normal P-P plot of regression standardized residuals, with AQC-P scores as the dependant variable.

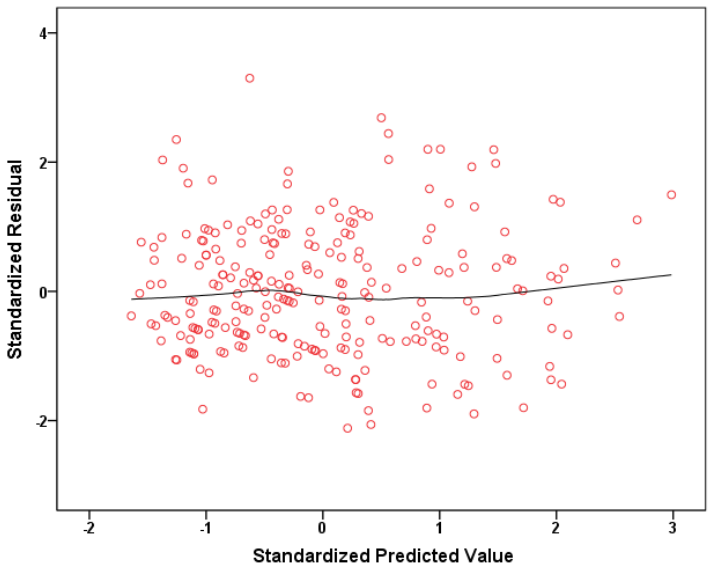

Figure A4.3.4. Scatterplot of standardised residuals and predicted values with Loess curve.

Appendix 5 for Chapter 6.

A5.1. *Additional measure in child questionnaire pack (ERQ-CA).*

PART THREE

In this part, please read the sentences and circle the choice that seems best for you.

1	When I want to feel happier, I thinking about something different.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
2	I keep my feelings to myself.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
3	When I want to feel less bad (for example, sad, angry or worried), I think about something different.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
4	When I am happy, I am careful not to show it.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
5	When I'm worried about something, I make myself think about it in a way that makes me feel better.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
6	I control my feelings by not showing them.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
7	When I want to feel happier about something, I change the way I'm thinking about it,	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
8	I control my feelings about things by changing the way I think about them.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
9	When I'm feeling sad (for example, sad, angry or worried), I'm careful not to show it.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**
10	When I want to feel less bad, (for example, sad, angry or worried) about something, I change the way I'm thinking about it.	**Strongly Disagree**	**Disagree**	**Half and Half**	**Agree**	**Strongly Agree**

Appendix 6 for Chapter 7.

A6.1. *Additional measure in child questionnaire booklet (SCARED-C).*

PART FOUR

Think back to how you've been feeling recently and tick the box that describes how you've felt the best.

		Not True	Sometimes True	Very True
1	When I feel frightened, it is hard to breathe.			
2	I get headaches when I am at school.			
3	I don't like to be with people I don't know well.			
4	I get scared if I sleep away from home.			
5	I worry about other people liking me.			
6	When I get frightened, I feel like passing out.			
7	I am nervous.			
8	I follow my mother or father wherever they go.			
9	People tell me I look nervous.			
10	I feel nervous with people I don't know well.			
11	I get stomach aches at school.			
12	When I get frightened, I feel like I'm going crazy.			
13	I worry about sleeping alone.			
14	I worry about been as good as the other kids.			
15	When I get frightened, I feel like things are not real.			
16	I have nightmares about something bad happening to my parents.			
17	I worry about going to school.			
18	When I get frightened, my heart beats fast.			
19	I get shaky.			
20	I have nightmares about something bad happening to me.			
21	I worry about things working out for me.			
22	When I get frightened, I sweat a lot.			
23	I am a worrier.			
24	I get really frightened for no reason at all.			
25	I am afraid to be alone in the house.			
26	It is hard for me to talk with people I don't know well.			
27	When I am frightened, I feel like choking.			
28	People tell me that I worry too much.			
29	I don't like to be away from my family.			
30	I am afraid of having anxiety (or panic) attacks.			
31	I worry that something bad might happen to my parents.			
32	I feel shy with people I don't know well.			
33	I worry about what is going to happen in the future.			
34	When I get frightened, I feel like throwing up.			
35	I worry about how well I do things.			
36	I am scared to go to school.			
37	I worry about things that have already happened.			

		Not True	Sometimes True	Very True
38	When I get frightened, I feel dizzy.			
39	I feel nervous when I am with other children or adults and I have to do something while they watch me (for example: read aloud, speak, play a game, play a sport).			
40	I feel nervous when I am going to parties, dances, or any place where there will be people that I don't know well.			
41	I am shy.			

A6.2. *Additional measure in parent questionnaire booklet (AQ-C).*

PART FIVE: YOUR CHILD'S BEHAVIOURS

Please answer each of the following questions about your child by ticking a box that reflects your answer to the question. If there is any question that you feel not able to comment, please ask the person to answer.

		Definitely Disagree	Slightly Disagree	Slightly Agree	Definitely Agree
1	They prefer to do things with others rather than on their own.				
2	They prefer to do things the same way over and over again.				
3	If they try to imagine something, they find it very easy to create a picture in their mind.				
4	They frequently gets so strongly absorbed in one thing that they lose sight of other things.				
5	They often notices small sounds when others do not.				
6	They usually notices house numbers or similar strings of information.				
7	They have difficulty understanding rules for polite behaviour.				
8	When they read a story, they can easily imagine what the characters might look like.				
9	They are fascinated by dates.				
10	In a social group, they can easily keep track of several different people's conversations.				
11	They find social situations easy.				
12	They tend to notice details that others do not.				
13	They would rather go to a library than a birthday party.				
14	They finds making up stories easy.				
15	They are drawn more strongly to people than to things.				
16	They tend to have very strong interests, which they get upset about if they can't pursue.				
17	They enjoys social chit-chat.				
18	When they talk, it isn't always easy for others to get a word in edgeways.				
19	They are fascinated by numbers.				
20	When they read a story, they find it difficult to work out the characters' intentions or feelings.				

		Definitely Disagree	Slightly Disagree	Slightly Agree	Definitely Agree
21	They don't particularly enjoy fictional stories.				
22	They find it hard to make new friends.				
23	They notice patterns in things all the time.				
24	They would rather go to the cinema than a museum.				
25	It does not upset them if their daily routine is disturbed.				
26	They don't know how to keep a conversation going with their peers.				
27	They find it easy to "read between the lines" when someone is talking to them.				
28	They usually concentrate more on the whole picture, rather than the small details.				
29	They are not very good at remembering phone numbers.				
30	They don't usually notice small changes in a situation, or a person's appearance.				
31	They know how to tell if someone listening to them is getting bored.				
32	They find it easy to go back and forth between different activities.				
33	When they talk on the phone, they are not sure when it's their turn to speak.				
34	They enjoy doing things spontaneously.				
35	They are often the last to understand the point of a joke.				
36	They find it easy to work out what someone is thinking or feeling just by looking at their face.				
37	If there is an interruption, they can switch back to what they were doing very quickly				
38	They are good at social chit-chat.				
39	People often tell them that they keeps going on and on about the same thing.				
40	When they were in preschool, they used to enjoy playing games involving pretending with other children.				
41	They like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).				
42	They find it difficult to imagine what it would be like to be someone else.				
43	They like to plan any activities they participate in carefully.				
44	They enjoy social occasions.				
45	They find it difficult to work out people's intentions.				
46	New situations make them anxious.				
47	They enjoy meeting new people.				
48	They are good at taking care not to hurt other people's feelings.				
49	They are not very good at remembering people's date of birth.				
50	They find it very easy to play games with children that involve pretending.				

A6.3. *Additional graphs from regression analysis in section 7.3.6 and 7.4.6.*

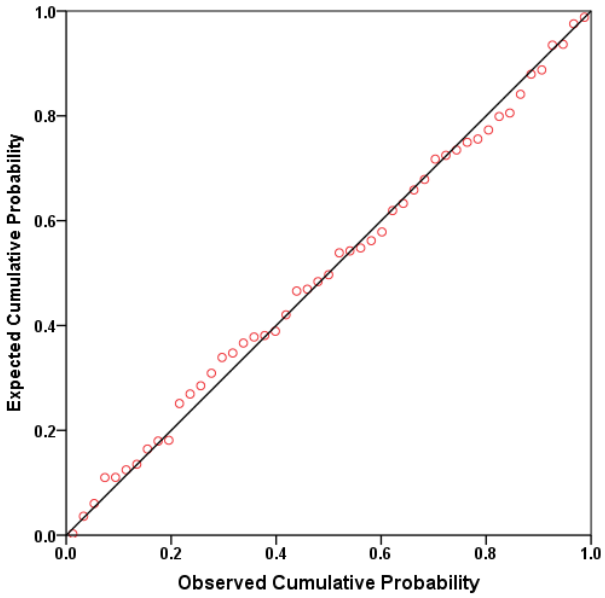

Figure A6.3.1. Normal P-P plot of regression standardized residuals, with sad AFR scores as the dependant variable.

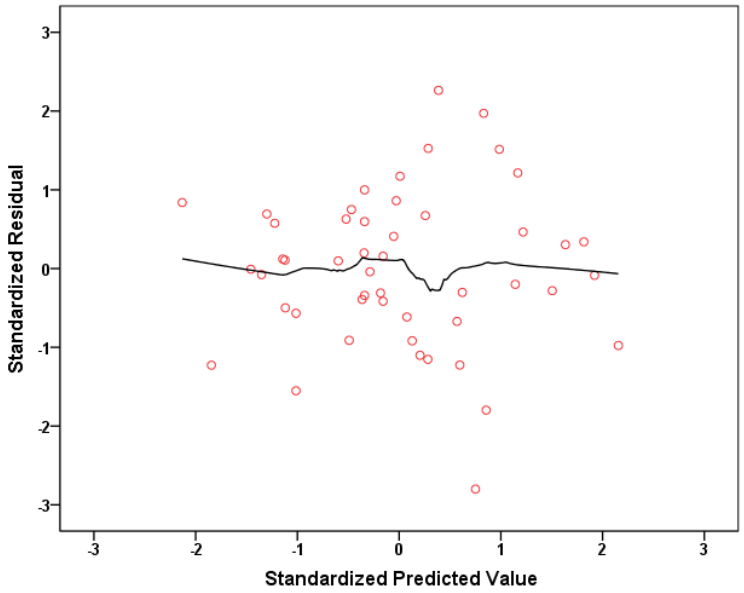

Figure A6.3.2. Scatterplot of standardised residuals and predicted values with Loess curve.

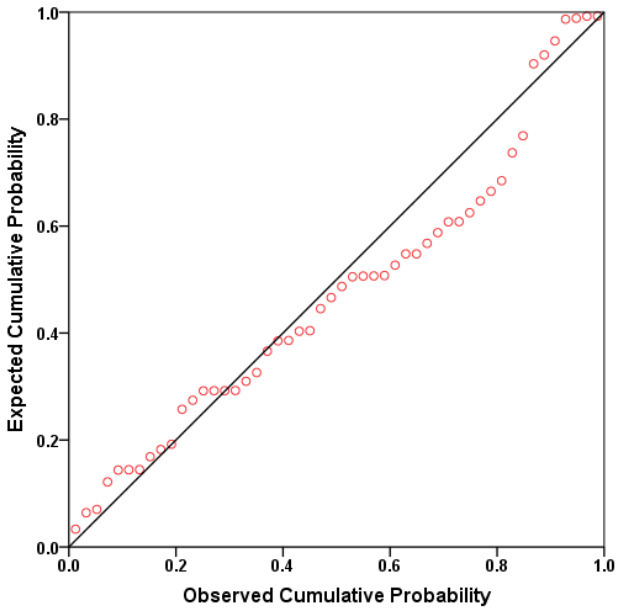

Figure A6.3.3. Normal P-P plot of regression standardized residuals, with happy AFR scores as the dependant variable.

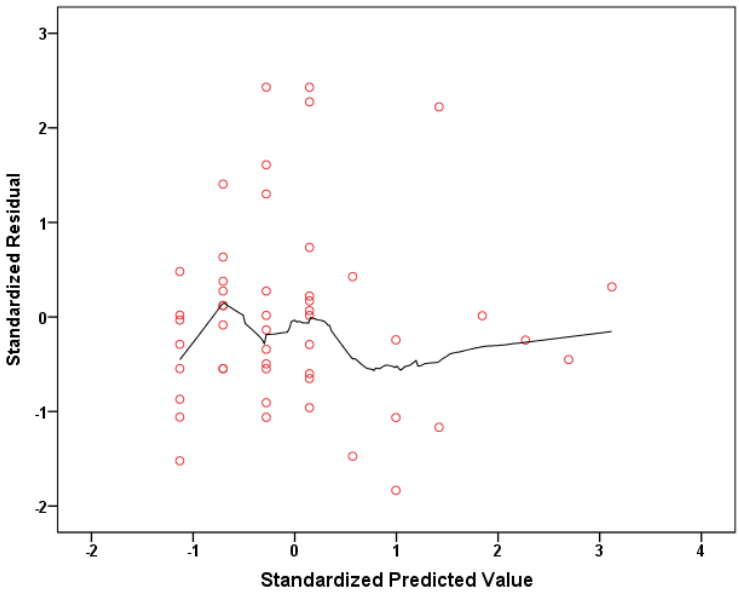

Figure A6.3.4. Scatterplot of standardised residuals and predicted values with Loess curve.